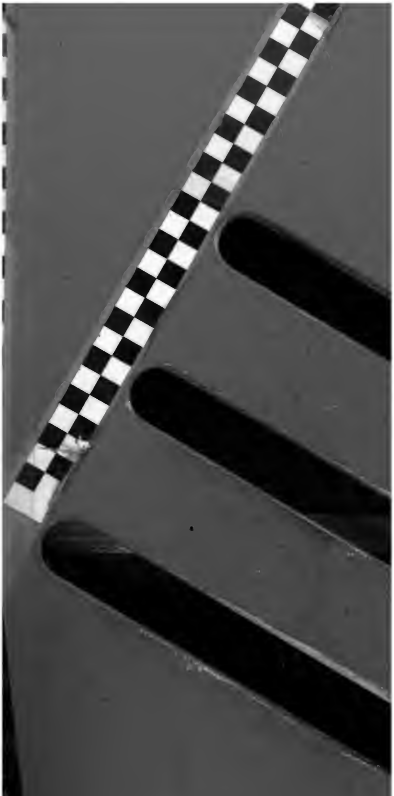

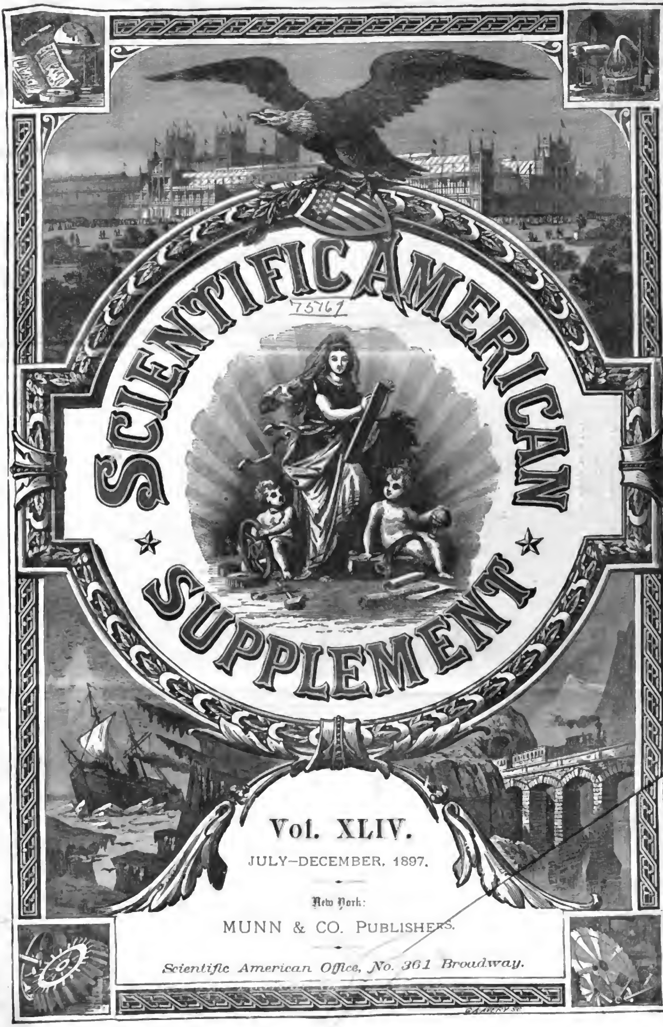
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THE BLACKWALL TUNNEL BENEATH THE THAMES.

THE Blackwall Tunnel, which easily takes rank as one of the great engineering works of the age, was formally opened for public use on May 22 last in the presence of their Royal Highnesses the Prince and Princess of Wales, the London County Council, and other dignitaries.

The story of the difficulties, seen and unforeseen, encountered in carrying out this great undertaking can best be told in the words of the engineers who were in immediate charge of the work. By the courtesy of Mr. Maurice Fitzmaurice, one of the resident engineers, we are enabled to present the following extract of a paper read by himself and Mr. David Hay, members of the Institution of Civil Engineers, before the meeting of the Institution held April 6, 1897.

About the year 1875 it became generally recognized that the construction of more river crossings below London Bridge could not be further delayed, and the matter was taken up by the Metropolitan Board of Works, who brought forward several schemes both for bridges and tunnels; but it was not until 1887 that the Blackwall Tunnel Act was obtained. The design, as proposed by Sir Joseph Bazalgette, consisted of three tunnels, two for vehicular traffic and one for foot passengers; and it was determined to construct the latter in the first instance. The internal diameter was to be fifteen feet, and the tunnel was to be made of cast iron, and to be lined with brickwork. Tenders for this work were invited, and it was decided to let it to Messrs. S. Pearson & Son; but owing to the Metropolitan Board of Works being replaced by the London County Council, and the latter body considering that a larger tunnel ought to be made at once, the contract was never carried out. It was then three years before the final decision was made, and at the end of 1891 the contract for the present tunnel was obtained by Messrs. S. Pearson & Son, the amount of their tender being $4,215,640. The total length of the tunnel is 6,200 feet, 1,220 feet of which are below the river. The lengths adopted for each type of construction are shown in Fig. 2, that of the east iron lined portion being 3,112 feet.

NORTHERN ENTRANCE TO THE TUNNEL.

OPEN APPROACHES.

The open approaches on each side of the river extend from the ends of the cut and cover work to the points where the roadway attains the existing road levels. The construction adopted consists of concrete and brick retaining walls with a concrete invert between them. On the Middlesex side the excavation was almost entirely in clay or made ground, and there was little difficulty with water. On the Kent side the work at the deep end was almost wholly in water-laden ballast. The side walls were first built in timbered trenches, and the dumpling was afterward excavated and the invert inserted. The brickwork has a white glazed face and is bonded into the concrete, being alternately 9 inches and 18 inches thick, in equal lengths of 3 feet. As water tightness was absolutely necessary, the walls were coated with 1½ inch of asphalt, which was carried down the back to within three feet of the bottom and thence across through the invert. This gave a continuous water tight layer completely surrounding the work, which has proved satisfactory.

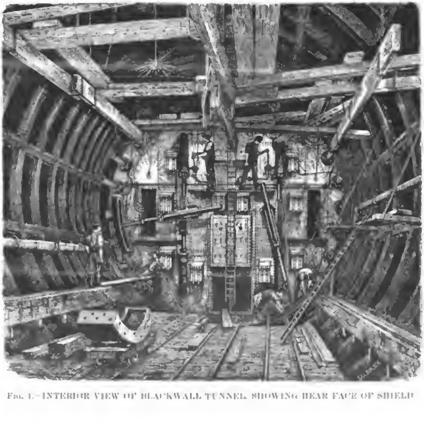


FIG. 1.—INTERIOR VIEW OF BLACKWALL TUNNEL SHOWING REAR FACE OF SHIELD.

CUT AND COVER PORTION.

The first section of the cut and cover portion consisted of four layers of brickwork, built in concentric rings, surrounded by a band of asphalt 1½ inch thick, and by 6 to 1 cement concrete which was backed up by clay puddle. The puddle backing, however, was found unsatisfactory, notwithstanding the fact that it was rammed as stiff and solid as possible, as the side walls began to spread slightly when the filling was placed on the arch. To prevent further movement, piles were driven through the filling into the puddle, the use of which was thereafter discontinued and another section substituted. The concrete was built tight to the sides of the trench, and the asphalt was mainly relied upon for water tightness. The arch on the Middlesex side was also built to this section. In the deeper part of the cut and cover portion substituted for the iron lined tunnel, on the Kent side, an extra ring of brickwork was added.

SHAFTS.

There are four shafts in the line of the tunnel; Nos. 1 and 2 situated on the north side, and Nos. 3 and 4 on the south side of the river. Their positions, Fig. 2, were determined by the horizontal or vertical changes of direction of the tunnel, which was driven straight from shaft to shaft, the difficulty of driving the shield on a curve and the trouble and expense of special castings being thereby avoided.

Caissons.—The caissons, Figs. 8 and 9, are 48 feet in internal and 58 feet in external diameter, and are formed of two skins, partly of steel and partly of iron. The plates, generally 4 feet in depth, vary in thickness between ⅜ inch at the bottom and ⅝ inch at the top. The lower portion is constructed of steel to 8 feet 6 inches above the cutting edge. The space between the skins, 5 feet near the cutting edge and reduced by the outside batter to about 4 feet at the top, is filled with 6 to 1 Portland cement concrete. There is an internal lining of brickwork with a glazed face, the finished diameter of which is 45 feet 8 inches. The floors of shafts are formed of 6 to 1 concrete 11 feet thick.

Two openings are formed in each shaft, 29 feet 4½ inches in diameter, on the center line of the tunnel, and the caisson is strengthened round them by vertical and radial diaphragms. These openings were closed during the sinking by iron shutters bolted together so as to be readily removable in sections capable of being passed through the advancing shield.

Arrangements were made for attaching airtight floors to the inner skin of caissons, above the level of the tunnel openings, for use either in sinking the shafts or constructing the watertight floors, should compressed air be found necessary, and when it was required to drive the tunnel through. The floor consisted of ⅝ inch buckled plates resting on girders 15 inches deep; above these 4 foot girders were placed at right angles, the whole being surmounted by two girders 12 feet deep. When the air pressure exceeded 20 pounds per square inch above atmospheric pressure, the upward thrust on the floor was relieved by 10 feet or 14 feet of water ballast.

Method of Sinking.—The shafts on the south side of river were sunk by pumping down the water and removing the excavation from the inside in the ordinary way. The weight of caisson and concrete filling was generally sufficient to overcome the skin friction, until about 20 feet from the bottom, when more weight had to be temporarily added. The sinking of No. 4 shaft was accomplished without difficulty, but considerable trouble was experienced in dealing with No. 3 at the river bank. The ground for about 25 feet of the lower part of the shaft is composed of fine sand, and numerous "blows" were caused by the head of water in the ballast above (charged afresh by every tide), washing in large quantities of gravel and sand. The ground was of such a heavy, clinging nature that the caisson was often stationary for several days, although the cutting edge was free and the structure was heavily loaded; and it was not until a blow occurred, the movement of the ballast decreasing the skin friction, that further downward progress could be made. The caisson was at one time 14½ inches out of level, and various expedients were tried to induce blows on the high side in order to correct it. The best results were obtained by striking heavily on the

inside of the shaft with a balk of timber swung horizontally from a girder above.

As all the weight had been placed on the skins for which room could be found, the girders of the air-tight floor were fixed and loaded; better progress was then made, and when the top water was cut off no difficulty was encountered in dealing with the springs in the sand below the London clay; the floor was therefore constructed, as in the case of No. 4, without the aid of compressed air. The friction on the outside skin for the last 30 feet in the case of No. 3 amounted to about 675 pounds per square foot, the cutting edge being entirely free.

On the north side of river No. 2 shaft was sunk behind a new river wall (Fig. 2), which had been built to reclaim part of the foreshore. The whole of the ground to be penetrated consisted of ballast; and it was decided to employ a grab for the excavation, allowing the water to remain inside. The total weight of the caisson and sinking load amounted to nearly 4,000 tons, the skin friction being therefore about 500 pounds per square foot of outside surface.

The first 28 feet of No. 1 shaft were sunk in the same manner as Nos. 3 and 4, but on reaching this depth, large quantities of water were encountered, and the grab system was again used. This method was continued until the cutting edge had passed through the ballast and sufficiently far into the clay below to cut off the top water. The water inside was then pumped out and manual labor was again employed. Ultimately it was found necessary to construct the air-tight floor and carry the caisson down by the pneumatic process.

IRON LINED PORTION OF THE TUNNEL.

For about one-third of the distance across the river the tunnel had to be constructed through a bed of open ballast in direct communication with the river, and it was assumed that the pressure of air in this portion of the tunnel would have to be equal to that due to the head of water. It was not considered advisable for men to work in a pressure exceeding 35 pounds per square inch above atmospheric pressure. This maximum air pressure corresponds to a depth of 80 feet of water, and the bottom level of the tunnel was therefore placed at 80 feet below Trinity high water, or 67.50 below Ordnance datum. The tunnel had to be of sufficient diameter to allow a line of traffic in each direction and give two paths for foot passengers. A diameter of 27 feet was considered the minimum which would give sufficient accommodation for the traffic, and the top was thus within 5 feet of the bed of the river in the deep channel, the ground between the top of tunnel and river bed being open ballast.

Without the cast iron lining a great portion of the tunnel would have been almost impossible. In addition to its necessity as a support, at once solid, from which to shove the shield forward, the following points are to be considered:

(1) The work attains its full strength as soon as it is erected, and the difficulty in keeping pressure off green brickwork is avoided.

(2) The facility with which it can be erected. On some occasions 12 feet 6 inches of tunnel have been completed in 24 hours, and during that time only 7 hours was occupied in erecting the iron.

(3) A smaller thickness of lining is necessary than with brickwork, with correspondingly less excavation.

(4) The tunnel can be made absolutely watertight from the inside by calking.

(5) By immediately filling the space left by the shield at the back of the cast iron lining settlement is rendered impossible.

Two sections of lining have been used, both 27 feet in external diameter. The first consists of a tube 2 inches thick, having flanges 12 inches deep and between 2 inches and 3 inches thick; and the second is 1½ inch thick, with flanges 10 inches deep and between 1¾ inch and 2½ inches thick. The rings of both sections are 2 feet 6 inches in length, and are built up of 14 segments, about 6 feet long circumferentially, and a solid key at the top, together weighing about 14 tons 16 cwt. and 10 tons 10 cwt. in the heavy and light sections respectively. All joints are machined and the segments are joined without any packing between them. Recesses are formed on the inside of the flanges for calking, and the joints are thus made perfectly watertight. Holes, 1½ inch in diameter, are drilled and tapped in each segment for grouting, and were closed with screw plugs when grouting was completed. The segments are fixed together with 1¼ inch bolts of the various lengths required, each being provided with a grummet.

THE SHIELD.

The shield, which is constructed of steel, is shown in Figs. 1 and 6, and was designed by Mr. E. W. Moir, M. Inst. C.E. The problem which the contractors had to deal with in its design was complex, and the satisfactory completion of the tunnel shows the success with which the situation was met. It was known that the ground to be passed through consisted of clay, sand and ballast, that there were probabilities of meeting large bowlders, and that the hard beds forming the base of the London clay would be encountered. In London clay a shield with an open face was desirable, and one was required in which the whole or any part of the face could be closed in the ballast under the river channel. Provision had also to be made for the removal of bowlders, trunks of trees, or other obstacles in front of the shield. Its strength should be sufficient to resist all possible pressure which might come on it either when compressed air was or was not in the tunnel and shield, or when there was compressed air

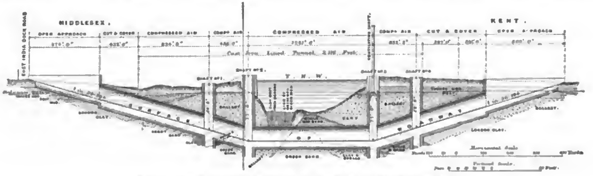


FIG. 2.—LONGITUDINAL SECTION ON CENTER LINE OF TUNNEL.

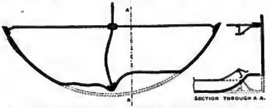


FIG. 3.—MISHAP TO PLATE STEEL CUTTING EDGE OF SHIELD.

FIG. 4.—CROSS SECTION OF CAST IRON LINING.

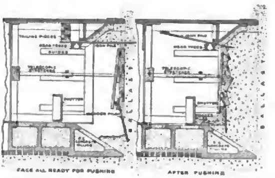


FIG. 5.—SKETCH SHOWING METHOD OF ADVANCING SHIELD.

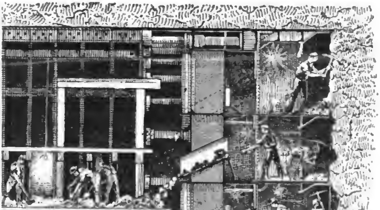


FIG. 6.—SECTIONAL VIEW OF HYDRAULIC SHIELD.

in front of the shield and not in the tunnel. Sufficient strength was also required to take up the maximum pressure from the rams at the back when it was necessary to force it forward; bearing in mind the fact that the pressure of the rams might be more or less unequally distributed, owing to some rams being shut off at times in order to correct any deviation from line or level. In addition to these requirements every precaution had to be taken to insure the safety of the men working at the face.

The total length of the shield was 19 feet 6 inches, and the outside diameter was 27 feet 8 inches. The outer shell or skin, 2½ inches thick, consisted of four thicknesses of ⅝ inch steel plates, twenty-eight plates extending the full length of the shield to each ring, and, consequently, all the joints were longitudinal. In some previous shields cross joints had been adopted,

MAURICE FITZMAURICE, M.I.C.E., RESIDENT ENGINEER OF THE BLACKWALL TUNNEL.

and the plates had been ripped up at these joints. The plates in the different rings broke joint with each other, and all the rivets were countersunk on the outside.

The first portion of the inner shell, beginning at 6 feet 8 inches from the rear end of the shield and extending forward for a length of 6 feet, was 24 feet in diameter, and consisted of a ¾ inch plate, the space between it and the outer skin forming cells for the hydraulic rams. The second portion was 25 feet 3 inches in diameter, and was made of ⅝ inch plate. This portion takes up a certain amount of the thrust of the hydraulic rams, and is sloped down to meet the outer skin near the face, but the actual cutting edge was formed of the outer skin only. The outer and inner skins were strongly braced together by circular girders; in the webs of the two rear of which, holes were cut for the passage of the ram cylinders. The forward half of the shield was stiffened by three horizontal and three vertical plate diaphragms which also served to divide the working face into four floors and twelve compartments. There were two plate diaphragms stiffened by vertical girders at right angles to the axis of the shield, one placed at about the center of the shield and the other about 3 feet behind it. Access to the second and bottom floors was provided for by hatchways from the floors above, but in the case of the bottom floor two plates in the diaphragm were afterward removed, and doors were fixed to allow of direct access from the tunnel.

An inclined soil shoot, fitted with rubber faced doors at each end, was provided for each of the twelve compartments, but the doors, like those for the air locks, were never required except for closing the face in emergencies. At 6 feet 7 inches back from the cutting edge were placed the vertical iron screens previously referred to.

The rear end of the shield for a length of 6 feet 8 inches consisted of the outer skin only, and in this tail the tunnel segments were built. The tail was long enough to always envelop the last ring erected, even when the shield was shoved forward far enough to give room for the erection of the next ring. At the extreme end of the tail there was a bead or curved narrow plate extending round the inside. This allowed more working space for the adjustment of the ring to be erected, and at the same time permitted greater freedom in deflecting the shield if for any reason it was required to change its direction.

The number of hydraulic rams originally provided for advancing the shield was twenty-eight; they were 8 inches in diameter and had a stroke of 4 feet; but while driving through the wet sand and ballast under the river this number of rams was found insufficient, and was therefore increased by six other rams, 10 inches in diameter, but with a shorter stroke. The maximum water pressure used was about 2¼ tons to the square inch, or a total, when all the rams were employed, of 5,165 tons, making no allowance for the friction of the rams.

Two hydraulic erectors, Figs. 1 and 10, for lifting the tunnel segments into place, were carried on the back of the shield. The circular motion of the arm was obtained by a rack on a piston working vertically between two hydraulic cylinders which revolved a pinion on which the arm was fixed. A movable arm was lengthened or shortened by another jack fixed on the base of the arm, and a small movement in the plane of the length of the tunnel was obtained by a tangent screw near the pinion. A water pressure of 1,000 lb. to the square inch was used for working the erectors. In Fig. 1 one of these erectors is shown lifting a segment into place.

DRIVING THE TUNNEL.

After the shield had been placed in the tunnel opening of No. 4 caisson (in which cast iron guides had been bolted to insure true line and level being followed), a portion of the cast iron lining, extending to the other side of the shaft, was temporarily built up behind the shield to form an abutment for the hydraulic rams in driving the shield forward. The plug was then removed from the tunnel opening (Figs. 8 and 9), and the shield began its forward movement.

At first progress was somewhat slow, only 125 ft. being driven in the first two months, but after the gravel disappeared and the top heading was discontinued, better progress was made, an average length of 25 ft. being completed per week. An accident, however, soon after happened to the shield which caused some delay. At the base of the London clay, and in the sand immediately below it, large pieces of rock were embedded and considerable damage was caused to the cutting edge by driving against them, and, after 80 rings had been erected, the shield was found to be unworkable. As it was not practicable to repair it in its then position, it was decided to construct a concrete cradle for it to slide upon. A timbered heading, 19 ft. wide, was therefore driven and kept about 50 ft. in advance of the shield, so that the concrete should have time to become hard before the shield came upon it. During the driving of this heading trouble was again experienced from water in the ballast above finding its way through cracks in the clay, and the top heading was accordingly recommenced, so as to intercept the water and carry it through the shield. This method of working was continued until No. 3 shaft was reached, where the repairs to the shield were effected.

R. W. MOIR, M.I.C.E., ENGINEER FOR THE CONTRACTORS.

On the arrival of the shield at No. 3 shaft it became necessary to undertake the repairs required on account of the buckling of the cutting edge. It was decided to cut away the distorted portions of the skins and vertical stiffener, Fig. 3, and substitute heavy steel castings, as shown in Fig. 5. At the same time the projecting plates of the undamaged part of the cutting edge were cut off, and, although sharpness was thereby lost, the edge was much stronger to sustain a blow against any obstacle in front. The steel castings were made to a larger radius than the outside skin, so that they should stand "proud" of it and thus decrease the skin friction when the shield was being pushed forward. A steel band, ⅝ inch thick, was also carried round the outside of the undamaged part of the cutting edge, with the same object, and to further strengthen it. Most of the repairs were executed in the ordinary atmosphere; they were commenced on May 28, and completed on August 25, thus extending over a period of thirteen weeks. In carrying out the repairs a great number of holes had to be drilled, and flexible shafts driven by electric motors were used to great advantage. The motors were fixed in the shield and current was supplied from dynamos on the surface.

Under the River.—The portion of the tunnel between No. 2 and No. 3 shafts includes all the work actually beneath the Thames. The length from center to center of the shafts is 1,222 feet. There is a layer of London clay between the tunnel and the river bed for nearly three-fifths of the distance; the clay is then lost, and what was probably an older and deeper bed of the river, now filled with ballast, was met with (Figs. 2 and 7). As was anticipated, the work was carried out expeditiously, and without difficulty in maintaining a sufficient pressure of air as long as the clay cover continued. In starting from No. 3 shaft the upper part of the shield was in clay and the lower part in sand. The rate of progress here surpassed that in any similar tunnel yet constructed. In two months more than 500 feet of tunnel were completed, and occasionally five rings, or a length of 12 ft. 6 in., were constructed in 24 hours. During a day, therefore, 300 cubic yards of material was excavated and about 75 tons of cast iron erected. When it is considered that these materials, in addition to lime, other necessaries and empty wagons, had to pass through

SOUTHERN ENTRANCE TO TUNNEL.

the air locks, it will be apparent that very careful organization on the part of the contractors was required.

In penetrating the old river channel the shield passed within about 5 ft. of the bed of the river, the material above being open ballast. Previously to reaching this point permission had been obtained from the Thames Conservancy to tip a temporary layer of clay on the river bed for a length of 430 ft. in the line of tunnel. Its maximum depth was 10 ft., and it extended 75 ft. on each side of the center line. It offered resistance to the air escaping from the tunnel through the open ballast, and its weight prevented the bed of the river from being blown up by the pressure. The clay was deposited from hopper barges, and was removed as the tunnel was completed.

The shutters for closing the face of the shield, Fig. 1, were invaluable when passing through ballast or any open material. As the face had to be kept closed while the shield was being moved forward, it was evident that they must have a sliding movement, so as not to become broken up when the shield was advancing, as would be the case if the face was timbered in the usual way. In each compartment of the three upper floors there were three shutters. They varied in depth between about 2 ft. 3 in. and 1 ft. 6 in., and were of varying lengths to suit the different compartments. Each consisted of a ⅜ in. iron plate, stiffened at the edges by heavy angles, and sliding on guides fixed to the sides of the compartment. The shutters were controlled by long screws, fixed to their ends and extending through bearings on the side of the compartment.

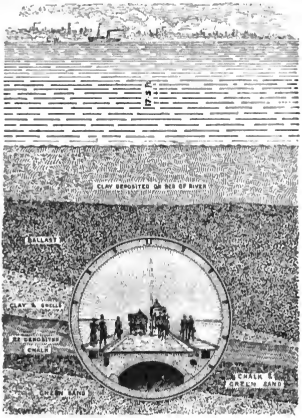


FIG. 7.—CROSS SECTION OF THE RIVER THAMES, SHOWING THE FINISHED BLACKWALL TUNNEL.

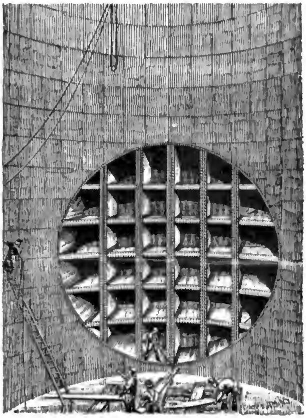


FIG. 8.—BOTTOM OF CAISSON, SHOWING TEMPORARY PLUG.

In the ballast, previously to shoving the shield forward, the face of a compartment was completely closed by its three shutters which had been screwed forward as close to the cutting edge as possible, the shutters being directly over each other, and the small space between them being filled with clay. When the shield was to be shoved forward the nuts on the screws were loosened on the forward side of the bearings, allowing the shutters to move back as the shield was shoved forward. Any sudden movement was guarded against by running the nut only 1 in. or so in front of the bracket at a time.

The method and rate of removal of this material depended on the consistency of the ballast, and whether the air pressure in the tunnel was sufficiently high. Under favorable circumstances the ballast might be shoveled out from the top of the shutters, or a shutter might be drawn somewhat further back and the material shoved out between that shutter and the next lower one; but in any case the top shutter was first excavated and screwed forward, and then those at the middle and bottom.

The sliding shutters were not used in the two bottom pockets, and in their place a combination of long horizontal iron piles and short vertical timber piling, Fig. 5, was adopted. By this arrangement it was possible to clear out the ballast up to the cutting edge, which could not be done with the shutters. Great difficulty was experienced in the bottom floor, and the men working here were generally standing in about 18 in. of water throughout the day. Perforated tunnel plates were occasionally built in to relieve the water at the face by allowing it to enter the tunnel further back. Jets of high pressure water were used at times at the face to keep the material moving while the shield was advancing, to diminish the pressure required to shove the shield forward. Small shots were also used to shake the ground and to remove any hard material; and a man was constantly employed testing the face with a bar in front of the shield to discover any large bowlders which might damage the cutting edge.

The difficulties encountered while driving through ballast suggest modifications in shields for tunneling similar material. The shutters should be placed as close as possible to the cutting edge, and their area in relation to that of the face should be as large as possible. Much of the difficulty in driving the shield was due to this difference of areas; it would probably be little felt in passing through soft material which flows easily, but in gravel the resistance from this cause is very great. Such modifications would probably necessitate a heavier shield, but great improvement in working would result. It would also be well to allow for a large increase in the power required for shoving the shield over that anticipated, as it is difficult to even roughly estimate it when it is necessary to work with a closed face.

An airtight hanging screen was always fixed a short distance behind the shield to insure the safety of the men. It reached down to the center of the tunnel and was fitted with an air lock at the top, the doors of which were hung to open toward the bulkhead; this could be reached by a gangway which was added to as the shield advanced. In the event of an inrush of water, the men could thus escape to the other side of the screen, where they would always find an air space, and thence, by a gangway, to the emergency lock in the bulkhead.

Serious "blow outs" occurred while working in the ballast, and on two occasions the air pressure fell so suddenly, and the water from the river poured in so fast in the two upper floors that the tunnel was flooded to a depth of 7 or 8 feet in a few seconds. The first of these blows occurred on the 30th of April, 1895, and the second and largest about a week later, when about three-quarters of the distance across the river had been covered. The escape gangway had not at that time been provided, and, owing to the dense fog, caused by the sudden fall of air pressure, completely

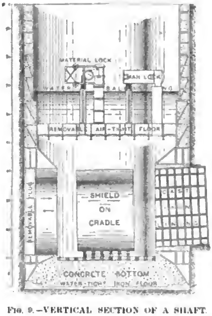


FIG. 9.—VERTICAL SECTION OF A SHAFT.

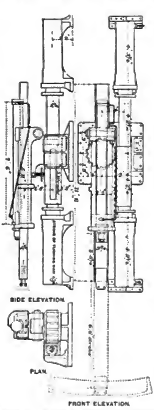


FIG. 10.—DETAILS OF HYDRAULIC ERECTORS.

obscuring the electric lights, the men had difficulty in escaping back to the lock, then distant about 700 feet. The clay which had been placed on the bed of the river was then of the greatest possible value; it followed down upon the ballast, which was washed in by the water as through a funnel, and, choking the passage, the air pressure soon increased. The immediate cause of these accidents would appear to have been the breaking down by the rising tide of a large area of the hard crust on the river bed left unsupported by runs of ballast from beneath it. Great care was afterward taken to look out for and fill such cavities with sawdust. This material was found to be very convenient for the purpose, the escaping air carrying it into the cavity through the hand holes in the sliding shutters. It will be noticed that for a length of 190 feet the river crust continued to break away and allowed the clay, deposited on the river bed, to enter the shield; but as long as there was no cavity, and consequently no liability of a large area of crust suddenly giving way, no danger was to be apprehended. In addition to carefully watching out for cavities in the front of the shield inside the tunnel, soundings were taken in the river in front of the shield every day to discover any subsidence of the clay. The cutting edge of the shield touched No. 3 shaft fifty-four weeks after the first ring was erected in No. 3 shaft.

Before removing the plug in the opening of No. 2 shaft, iron piles were driven from the inside of the shaft over the top of the shield, provision for this having been made in building the plug. The work of driving the shield into the shaft was then comparatively easy. The shield was found to be in as good condition as when it left No. 3 shaft, which, considering the severe treatment it received on its journey, speaks well for the excellence of its construction.

The air compressing plant, boilers, etc., were taxed to their utmost capacity during most of the work through the ballast, some of the compressors working with scarcely a stop for twelve months. Considerable repairs were consequently necessary before the tunnel beyond No. 2 shaft could be proceeded with. They occupied some weeks, and the contractors took the opportunity during the suspension of work to invite a number of visitors to celebrate the accomplishment of what must be considered the most difficult piece of subaqueous tunneling ever undertaken, luncheon being provided in the tunnel about midway across the river.

No. 2 Shaft to Railway.—Early in December work was resumed; the shield having been placed in position in the tunnel opening on the north side of the shaft, and the temporary iron lining built behind to take the thrust of the hydraulic rams, the airtight floor, which had been partly removed, was again closed, the air pressure applied and the plug removed. The face at this point, as under the latter part of the river, consisted entirely of ballast fully charged with water. The same difficulties were therefore met with both in removing the plug and for some distance in driving the tunnel, necessitating almost the same caution. Beyond small subsidences near the shaft, however, no accident occurred, and No. 1 shaft was reached on the 10th of April. A slight delay was occasioned at this point by the difficulties referred to in constructing the bottom floor of the shaft, but by the middle of May the shield had passed through and had been adjusted to the new line to be followed to join the "cut and cover" portion at the railway. A distance of about 800 feet remained, and it was accomplished by the end of September of the same year.

All the cast iron portion of the tunnel is lined with 4 to 1 Portland cement concrete and faced with white glazed tiles 9 inches by 3 inches to preserve uniformity of appearance with the brick facing in the cut and cover portion of the work. Throughout the cast iron lined tunnel and the cut and cover the roadway is carried on a 9 inch brick arch leveled up with concrete as shown in Fig. 7. The subway thus formed gives ample room for two large water mains or for a ventilating trunk if necessary. Provision is made for ventilation by building in at intervals pipes 2 feet 6 inches by 4 inches following the curve of the side of the tunnel and having an opening at the crown. These pipes are continued downward to the subway under the road, where they can be connected to a main ventilating pipe which can be exhausted by fans at shafts Nos. 2 and 3. The width of the roadway is 16 feet throughout, and there is a 3 foot footpath on each side of the tunnel increased to 5 feet 8 inches in the open approaches. The gradients of the approaches are 1 in 30 and 1 in 34 on the Kent and Middlesex sides respectively. The drainage of the roadway is taken by gullies 50 feet apart on alternate sides, and from thence it is conducted by 6 inch and 9 inch pipes to No. 2 shaft, and there it is pumped to the surface. The roadway for the level portion of the tunnel under the river is of asphalt, and for the approaches on each side granite sets laid in pitch and tar, the gradients on the latter portions being too steep for asphalt. For ordinary cart traffic access to the tunnel can only be obtained at the ends; but for the convenience of pedestrians stairways are provided at four other points, viz., at the junction of the "cut and cover" and "open approach" on each side of the river, and at Nos. 1 and 4 shafts.

MACHINERY.

There were six air compressors of a total capacity of about 1,300 horse power. The two largest, of about 300 horse power each, were manufactured by Messrs. Walker Brothers, of Wigan; two were made by the Ingersoll Company, of New York; one by the Haslam Engineering Company and one by Messrs. Slee. A smaller compressor was also in use for the air required for grouting purposes. During a large portion of the time, while passing through loose ballast, as much as 10,000 cubic feet of air per minute was sent into the tunnel. It was carried into the tunnel by steel riveted pipes 8 inches in diameter, taken down No. 4 shaft on the Kent side, and thence along the tunnel as completed to the end at the Middlesex side. When the air was escaping freely at the face, the amount pumped through these pipes was very large, and the velocity consequently very high. On this account the difference between the air pressure in the engine house and in the tunnel sometimes showed a loss of 40 per cent. It is evident that for a long tunnel it would be economical to have pipes of ample size, so that the velocity of air could be kept at say about 30 feet per second, as the extra cost of pipes would soon repay itself. The air for grouting purposes, the pressure of which was about 40 pounds per square inch greater than that for the tunnel, was carried in a 5 inch pipe. The high pressure water for the rams was carried in a steel pipe 1¼ inch in diameter, and as the end of the pipe was connected with the moving shield, a "walking joint" was used at some distance back from the face.

Electric incandescent lamps were used for lighting throughout the construction of the work to avoid vitiation of the atmosphere by lamps or candles as much as possible. An electric light installation has been erected on the Middlesex side of the river for the permanent illumination of the tunnel and also to supply current for working the drainage pumps and a small lift in No. 2 shaft. The tunnel will be lighted by three rows of incandescent lamps of 32 candle power, fixed 10 feet apart on alternate lines, with additional lamps and a few arc lights in the shafts. The open approaches will be lighted by groups of incandescent lamps.

The London County Council showed great interest in the health of the men employed in compressed air; and a stringent clause was inserted in the contract specifying among other particulars proper ventilation at the working face, the provision of lifts and resting places for the men, including a compressed air chamber fitted with locks, and that no workman should be engaged for compressed air work without his fitness for such duties being proved by previous experience or by medical examination. After the commencement of the work the Council obtained parliamentary powers to compensate men who might be injured by working in compressed air, although the men were not employed directly by the Council. A resident medical officer, Dr. E. H. Snell, was also appointed to examine all men previous to working in the compressed air, or who might be injuriously affected by it, and to thoroughly investigate the nature of compressed air illness. The cases of illness due to compressed air were few, and only three cases of permanent illness have been attributed to this cause, and there were no deaths. This is probably due to the fact that a sufficient supply of air was delivered, and that the men did not work in too long shifts. The general period of work was 8 hours, but there was a break of ¾ hour in this time as near the middle as possible. Hot coffee was supplied by the contractors to the men in the middle of their shift and also before coming out, and proper drying rooms with lockers were provided for their clothes.

COST.

The cost of work of this class is naturally of great interest; but the risks incident to tunneling in gravel within a few feet of the bed of a navigable river must generally render the contract cost of such works of uncertain value.

The cost of the completed work, as contracted for by Messrs. S. Pearson & Son, was $4,215,640, and, although there were some alterations from the contract quantities, the actual cost was below this amount. The contract price for heavy cast iron section was $630, and that for the light iron section $535 per lineal foot; the internal lining and roadway not being included in either case. The cost of the cut and cover portion, ranging in depth between 24 feet and 42 feet, was $295 per lineal foot; and for the portion ranging in depth between 42 feet and 65 feet, $535 per lineal foot, the roadway not being included in either case. The cost of the open approaches of an average depth of 35 feet below the surface was $185 per lineal foot, exclusive of the roadway.

The work was designed and carried out for the London County Council by their engineer-in-chief, Mr. Alexander R. Binnie, M. Inst. C.E., Sir Benjamin Baker, K.C.M.G., past president M. Inst. C.E., and the late Mr. J. H. Greathead, M. Inst. C. E., were consulted on several matters. The contractors were Messrs. S. Pearson & Son, whose representative and engineer on the work was Mr. E. W. Moir, M. Inst. C.E., who was responsible for the design of most of the special appliances used. The contractors had as chief assistants Mr. E. H. Tabor and Mr. G. H. Halden, Assoc. M.M. Inst. C.E., and Messrs. Everitt and Collingridge. The authors acted as joint resident engineers in charge of the work on behalf of the London County Council.

SMELTING FURNACE BURNING KEROSENE AS FUEL.

THE use of gas as fuel for smelting purposes is often rendered quite impossible by the distance separating the gas works from the furnace. The "Gold und Silber Scheideanstalt," of Frankfort on the Main, has constructed furnaces heated with kerosene, in which the oil is found to be a good substitute for gas, having quite as high a heating power.

The accompanying cut (Fig. 1) shows such a furnace, in which the greatest possible result is obtained with a very simple construction.

It will be seen on the diagram that the furnace is to be connected at F to a smoke flue providing a good draught. This involves no particular restriction in the choosing of the site for the furnace, as proper connections can be easily made in almost any locality.

Compressed air for the thorough combustion of the gases in the flame is provided by any suitable blower, and is admitted at x. It circulates under the burner, rising both on the inside and the outside thereof, and is driven into the flame, giving it a conical shape. In the annular burner there is an asbestos wick, D, which draws up the oil supplied from below through the pipe, S.

The flame is thrown against the bottom of the crucible, passes through the space between the crucible and inner shell, escapes by the opening at the top, and has to pass downward to get to the flue at F.

The circulation of the gases indicated by the arrows secures the most economical and complete use of the flame, and after as short a time as twenty minutes the temperature of the crucible is raised to 1,000° Centigrade, or to 1,300° in a very slightly longer time.

Our second cut shows a similar furnace, the compressed air being blown in centrally from the lower pipe, while the oil is delivered from the upper pipe to an annular chamber surrounding the wick. Here also the circulation of the flame is shown by arrows.

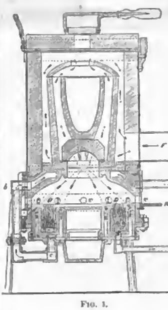


FIG. 1.

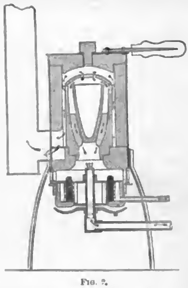


FIG. 2.

The first furnace will contain quantities up to 1,500 grammes of metal, while the second is constructed to hold as much as 20 kilogrammes. Any danger of explosion is absolutely avoided.

One of the most notable fleets of steamers hitherto constructed in the United States is designed for lake traffic—mostly iron ores—and bears the honored name of Sir Henry Bessemer. The vessels of the Bessemer fleet have been appropriately named after men famous for their connection with the mining, engineering, and metallurgical world. The flagship of the fleet is the Sir Henry Bessemer, while to the others have been given such names as Nasmyth, from the inventor of the steam hammer; Ericsson, from the builder of the Monitor; Corliss, the maker of engines; Krupp, Fulton, Watt, Siemens, Bell, Fairbairn, and Holley. Amid all the development of the lake marine and steel interests in the last few years it has strangely enough remained for this new company to honor the memories of the greatest men these industries have had by naming ships after them. These vessels were all built on a guarantee by the constructors of a capacity, on 14 feet draught, of 4,000 gross, or 4,480 net, tons. Each has slightly exceeded these figures. Were these vessels navigated on the draught of water for which they were built, they would be able to carry between 6,500 and 7,000 tons each, and they will be able to use nearly this depth of water this season, when the government's 21 foot channel between Duluth, Chicago and Buffalo will have been completed.—Iron and Coal Trades Review.

The Austrian government have placed a contract with Messrs. Yarrow & Company, of Poplar, for four first-class torpedo boats, of the improved Viper type. As the result of exhaustive experiments, the Austrian government have determined to fit the Yarrow boiler in the cruiser building at Pola, of 8,000 horse power. There will be eight boilers in all, having 2,500 ft. of heating surface each. These boilers, as well as the machinery for the vessel, will be constructed by the Stabilimento Tecnico, Trieste.

X RAYS AND PHOTOGRAPHIC COMPOUNDS: SOME RESEARCHES IN FLUORESCENT ACTION.

By V. E. Johnson, M.A.

It is a well known fact that when what have been termed the X rays fall upon certain chemical compounds they, by their stimulating action, cause them to emit a visible radiation to which the term fluorescence has been applied, the best known of such substances being sundry platino-cyanide salts, together with calcium tungstate and certain uranyl compounds—the best known because the most brilliant. The total number of bodies which fluoresce more or less under the stimulating action of the X rays is, however, very great, and increases, one might say, from day to day; so that it does not follow that that particular substance or compound which fluoresces with the maximum of brilliancy has as yet been discovered, although in the best screens undoubtedly a very large percentage of X ray energy is transformed, as is easily seen by placing two screens partly overlapping in contact, and observing the difference in illumination between the overlapping and non-overlapping parts, although this same difference may be due to another cause, as will be apparent later. It was not, however, with the intention of discovering, if possible, the most brilliant fluorescent substance, but rather, with the idea of gaining some knowledge with respect to the subject of fluorescence in general, that the following experiments, which led into many bypaths, were undertaken, the chemical compounds, etc., used in photography being chosen in preference as being ready to hand and of the greatest personal interest. It is to be hoped that the following brief account will be the means of inducing others who have not already done so to enter this fascinating field of research. The experiments were made with great care, in an absolutely dark room, with the Crookes tube (the ordinary focus pattern) completely incased in an opaque material, special measures being taken to completely screen off all light from the coil, such as that given off by the spark of the contact breaker, brush, discharge, etc. The spark used was a six inch one. The substances tried were in all cases, when necessary, ground to a powder in pestle and mortar, and dusted on to a piece of black cardboard through a fine sieve, no tacky substance, such as gum, collodion, etc., being used, nor was necessary, and was avoided by simply turning the tube round in such a fashion that the face of the platinum anode pointed upward instead of sideways or downward. Thus there was no waste of material. The pieces of cardboard dusted with the substance were held horizontally over the tube, and the chemicals returned to their respective bottles when done with. Much time and waste are obviated by this simple device, and possible errors arising from the presence of the tacky substance are avoided. The fluorescence in many cases was very faint, though not to be mistaken. A less powerful apparatus would probably give more negative and less positive results, and a more powerful one the opposite. Much, too, depends upon the physical nature of the body tried, but more of that anon. The substances tried with a negative result were the following: pyrogallic acid, alum (powdered), barium nitrate, collodion, lead acetate, mercury bichloride, caustic potash, sodium hyposulphite, glue, gum arabic, Epsom salts, potassium cyanide, potassium ferricyanide (solution), potassium ferrocyanide (solution), citric acid, sodium sulphite, sodium carbonate, tartaric acid, uric acid, borax, calcium sulphide (non-crystallized), uranium oxide, silver nitrate, chloride of silver, bromide of silver, and grape sugar.

The positive results were bromide of potassium, uranium nitrate, ammonium bromide, sodium acetate, sodium bicarbonate, chloride of sodium, mercury persulphate, chloride of gold, fluoride of potassium, hydroquinone, metol, amidol (very faint), potassium chloride, potassium citrate, potassium iodide, barium sulphide, fluoride of ammonium, calcium chloride. Potassium bromide was the most brilliant. The fact that the silver salts did not fluoresce led to an examination of the fluorescent action of glass. Glass of all kinds was found to fluoresce irrespective of shape, whether in the form of a plain sheet, a bottle, a prism, a lens, or a salt cellar of very irregular shape. That the shape made no difference was at once apparent, however, from the fact that the fluorescence was always and only on that side of the glass next to the Crookes tube. A bottle illustrated this very strikingly.

An ordinary photographic plate was found to fluoresce with sufficient distinctness to roughly make out the bones in ones hand. On removing the film from the glass the film still fluoresced, although not quite so brilliantly as the glass plate without the film.

The fact previously noticed, the non-fluorescence of the silver salts, led to an examination to discover the degree of fluorescence of gelatine and albumen. With respect to certain kinds both were found to be fluorescent. A piece of collodio-chloride printing paper (Paget) and a piece of unsensitized ordinary albumenized paper were found to be almost as brilliant as the photographic plate. A piece of bromide paper (Wellington & Ward's) showed no trace of fluorescence. Celluloid was found to be fluorescent, although not so brilliantly so as glass.

From these results it would appear that the fluorescence exhibited in the photographic plate is caused not (as has previously been supposed) by the fluorescence of the silver salts, but by the fluorescence of the substratum and support.

Various conclusions were drawn from these and many other experiments on this same mysterious and but little understood subject of fluorescence which may be here noted, as they may serve as a guide more or less to other future workers in the same field of research.

(1) The fluorescence of the substance is always on that side nearest the vacuum tube. This is well illustrated in the following cases: A glass bottle and a china saucer (the thicker portion on which the saucer stands appearing as a dark ring through the milky transparent whiteness of the whole). An unevenly dusted screen of some substance non-transparent to light, such as calcium tungstate, also exhibits this well—the thickly dusted portion appearing dark, the converted light rays from underneath (supposing the screen horizontal, fluorescent side uppermost) not being able to pierce the upper layers.

(2) An increase of fluorescent material is not necessarily an increase of brilliancy, but in time the reverse. A layer of non-crystallized calcium tungstate a quarter of an inch thick shows no fluorescence, a similar layer of uranium nitrate fluoresces well. A very thin layer of this same calcium tungstate fluoresces brilliantly.

(3) The substance should be in such a condition as to be as transparent to light as possible, and therefore (other reasons apart) a crystalline state is preferable.

For a good fluorescent screen it is also evident that the substance on which the fluorescent material is coated should be as transparent to the X rays as is possible, and that the coating of the screen should be as close as possible, so that no rays should pass through without filtration. If a tacky substance be employed, it would appear that it should possess as far as possible the characteristics of the fluorescent salt.

Among odds and ends that fluoresce under X ray stimulation may be mentioned powdered lump sugar, salt, and paraffin candles. Both transparent and opaque (to X ray radiation) substances fluoresce; many such could be quoted, but two of the most familiar are, perhaps, paste (chiefly lead glass opaque) and diamonds. Generally speaking, however, opaque bodies fluoresce the more brilliantly. It should be noted that glass is an amorphous body.

Genuine solutions of fluorescent substances (potassium bromide for example) are non-fluorescent. Chlorida of gold solution is, however, fluorescent; ordinary powdered sulphur non-fluorescent, but powdered roll sulphur fluorescent. Solutions must obviously be examined in a transparent non-fluorescent containing vessel.

As to whether the X rays exert any action of a primary character upon the silver salts seems much open to question; in any case it is of an extremely feeble character, and that we have in the silver salts the best sensitive recorder of X ray action seems most unlikely, although, of course, the unique power possessed by them of being so susceptible to rapid development when their altered molecules are but few in number is an advantage which could only be surpassed by some power of a like character possessed by another salt more susceptible to X ray energy.—Photography.

RECENT INFORMATION ON LIGHT ALLOYS.

Nickel-Tin-Aluminum Alloys.—These alloys are obtained by first melting pure aluminum, removing the dross and dirt from the surface, then putting in pure commercial nickel in thin sheets. The melting point of nickel is 1,500 deg. C., but under these conditions it is dissolved in the aluminum at 800 deg. to 900 deg. (bright red heat). The mixture is well stirred. When bluish sparks no longer appear on stirring, the tin is added. Three alloys are recommended, as follows:

	(1)	(2)	(3)
Aluminum	83	90	90
Nickel	2	3	4
Tin	15	10	10

The density of these alloys is 2·87 to 2·90. Alloy (2) is best for casting, as its shrinkage in sand is small. Alloy (3) is best for rolling, drawing or hammering.

Nickel-Iron-Aluminum.—These alloys are made in the same manner, melting 4 parts of nickel in 90 parts of aluminum and adding 1 or 2 parts of iron. The alloying requires, however, about 1,000 deg. C. to effect it. The alloy with 1 part of iron is very hard and very malleable; it rolls and may be forged; its elasticity is high, and it resists oxidation well.

Manganese-Copper-Zinc-Aluminum. — After a long series of experiments, De Susini is said to have found an alloy of these four elements which has very desirable qualities. The zinc, copper and manganese are first melted together in a plumbago crucible, and to make the final alloy the aluminum is melted and the necessary quantity of the first alloy added to it, keeping it at a red heat. Four mixtures are given, as follows:

Aluminum	97	95	92	90
Manganese	1·3	1·5	2·8	10
Copper	1·5	2·5	4·5	—
Zinc	0·5	1·0	1·5	—

Wolframinium.—This new alloy is due to Messrs. Reinhard and Isidore Roman. Its strength is quite high, showing a tensile strength when hard of 52,000 pounds, with 2 per cent. of elongation, and when annealed of 38,000 pounds, with 15 per cent. elongation. An analysis of the alloy has shown:

Aluminum	98·04
Antimony	1·44
Copper	0·37
Tin	0·10
Tungsten	0·04

Manganese or nickel may replace in it the copper, tin, or antimony. The metals are melted in the following order: Copper, tin, antimony, tungsten, aluminum, adding a small quantity of aluminum successively with each, in order to facilitate the melting. The Messrs. Lock, Lancaster, and W. & R. Johnson & Sons, of London, have acquired this alloy, and sell it in ingots, rods, etc. It casts easily in sand and moulds. Its color is white like silver. It resists reagents as well as pure aluminum, and has about the same specific gravity.

Partinium.—This is an alloy proposed by M. Partin, consisting of aluminum containing 4 to 10 per cent. of an alloy of copper, tin, arsenic, antimony and tungsten, or of an alloy of copper, tin, arsenic and aluminum.

Silicon-Aluminum.—Alloys of aluminum with up to 12 per cent. of silicon are strong and tough, but they deteriorate easily in the air or on contact with chemical agents, so that they cannot be used except well protected by paint or varnish.

Tin-Aluminum.—Alloys rich in tin, exposed to the air of a laboratory, become so brittle in a few days as to break of their own weight. They gain in weight by corrosion when left in water or even in the air. In water, the alloy with 15 per cent. of aluminum is most attacked. All these alloys are attacked by reagents more easily than either tin or aluminum alone.

Ferro-Silicon Aluminum.—Quite recently F. Krupp has found that an alloy containing 5 per cent. aluminum, 10 per cent. manganese, 10 per cent. silicon and 75 per cent. of iron is very suitable as an addition to molten steel. A simple alloy without manganese can also be used satisfactorily.—From L'Electrochimie.

SELECTED FORMULÆ.

To Shrink New Flannel.—New flannel should always be washed before it is made up. It can be cut out more accurately, and the grease extracted that it contains. Wash it in clean warm water, as warm as the hand can bear, and entirely by itself. Rub the soap to a lather in the water, or the flannel will become hard. Wash it in this manner through two warm waters, rinse it in another warm water, with just sufficient soap in it to give it a whitish appearance; to this water add a little indigo blue; wring and shake it well, and while drying shake, stretch and turn it several times. Flannel washed in this manner will be white and soft as long as it lasts. When dry let it be clapped and stretched with the hands, and rolled tight and smooth till wanted.

Cigar Flavoring.—

(1.) Macerate 2 ounces of cinnamon and 4 ounces of tonka beans, ground fine, in 1 quart of rum.

(2.) Moisten ordinary cigars with a strong tincture of cascarilla, to which a little gum benzoin and storax may be added. Some persons add a small quantity of camphor, or oil of cloves or cassia.

(3.) Tincture of valerian	4	drachms
Butyric aldehyde	4	"
Tincture vanilla	2	"
Nitrous ether	1	"
Alcohol	5	ounces
Water, enough to make	16	"

—Pharmaceutical Era.

Essences of Soap.—White Castile soap, 100 parts; alcohol, 80 per cent., 200 parts; pure carbonate of potash, 12 parts. The soap is dissolved in a wide mouthed bottle on the water bath by constant shaking with the alcohol, the carbonate of potash is then added. Then tint with saffron, or rosaniline and perfume. Leave for some days in the cold and filter. An excellent perfume for the above is obtained by mixing tincture of vanilla, 10; tincture of orris, 20; extract of rose, 20; extract of orange flowers, 50 parts. Bouquet recommends for the preparation of the essence: White soap, 1; alcohol, 85°, 3; distilled water, 1; and for medicinal purposes the following mixture, which lathers strongly in water: White Castile soap, 20; distilled water, 30; 90° alcohol, 60; potash, 1, and 1 per cent. of perfume.—Zeit. d. Allg. Œst. Apoth. Verein, x. 31.

Transferring Pictures, Prints, Etc.—In order to transfer prints of various kinds to glass, wood, etc., soak them for a short time in a solution of 10 parts of potassium hydrate in 90 parts of alcohol (more or less). This procedure is to soften the varnish in the printer's ink. After rinsing in pure water the print is placed face down on the plate which is receive the picture or print, covered with a dry sheet and then pressed with squeegee or in a letter press.

Colored prints are painted over with a colorless, sticky varnish, pressed against the object intended to receive them, and, when dry, the paper is removed by rubbing cautiously with an aqueous solution of potash.

Some years ago a French typographical journal gave the following curious process for the reproduction of any printed design whatever—pictures, printed pages, etc. The paper to receive the reproduction is treated with the following, which is applied with a sponge, or, preferably, with a soft, flat brush:

Gelatine	10	parts
Ferric chloride	22	"
Tartaric acid	10	"
Zinc sulphate	10	"
Distilled water	400	"

Mix in the dark, and keep in a deep, orange colored glass bottle (an ordinary bottle, tightly covered with a heavy, yellow colored paper, and kept in a close pasteboard box, will answer). The coating should be applied in a dark place, and the paper dried in the dark. When dry, place the design on the coated surface, and bring into close contact. Place on a sheet of glass, cover with another, clamp together, and expose to the direct rays of the sun until the yellow cover of the surface of the sensitive paper is bleached to a white. Remove from light, and develop by leaving for three or four minutes in the following:

Gallic acid	2	parts
Alcohol	7	"
Distilled water	100	"

If left exposed exactly the right length of time, the lines will appear on a white ground of an intensely black color. If exposed too long, they will become more or less gray.—Pharmaceutical Era.

Drying Sensitive Organic Substances.—To determine the moisture in soaps and other sensitive organic substances, C. C. Parsons (Jour. Am. Chem. Soc., Pharm. Jour.) uses an oil bath, putting the substance directly into a weighed quantity of hot oil, and weighing again after the moisture has been driven off. It is best to use neutral paraffin oil, without any admixture of animal or vegetable oils or fats, or mineral substances, and with specific gravity 0·920, flash test 437°, fire test 500°, and boiling point about 550°. The object of the high fire test is that the oil should be so freed from volatile matter that none of it will be carried off with the moisture in the substance to be dried. Ordinarily the whole operation may be completed in twenty minutes. It should be conducted in a drying closet kept at 240°. First, the oil is put into an evaporating dish and kept in the drying closet until it has the same temperature, then it is weighed and about one-sixth the quantity of the substance to be dried, weighed and added to it. If very moist, add in successive portions. The whole should be kept in the drying closet for a few minutes after effervescence has ceased. On again weighing, the loss indicates the amount of moisture driven off.—Pharmaceutical Era.

Mothol.—A pleasant deodorizer and moth preventive.

Alcohol	40	ounces
Tincture of capsicum	5	"
Naphthalene	1	"
Absolute phenol	1	"
Menthol	½	"
Oil of lemon grass	½	"

Mix and filter.

To be used in the form of a spray by means of an atomizer, where the moths frequent.—Chemist and Druggist.

ENGINEERING NOTES.

An interesting exhibit at the Tennessee Exposition is by the Sloss Iron and Steel Company, of Birmingham, Ala. It consists of a block of brown iron ore, 6 ft. high, 4 ft. wide, and 4 ft. long. It weighs about 5 tons, and is said to be the heaviest block ever mined in the State in one mass. It is stated that the company has a deposit of this ore 40 ft. in thickness at its mines near Leeds, Ala.

Sand tracks have been introduced into the gravity switching yard at Frederickstadt, Dresden, with a view to economizing labor, says Engineering. The trains here are marshaled by gravity, the grade provided being one per cent., which is sufficient to move the cars against the strongest east winds, but with a favorable wind the speed would be excessive were not means taken to check the speed of the cars. This has hitherto been done by brakes or by spragging the wheels. Recently, however, the sand track system has been adopted, the depth of sand over the rails being adapted to the atmospheric conditions prevailing day by day.

The compressed air workers have formed a union in New York. The longest time that the men say they can work in a day is eight hours, and that at a moderate depth. At great depth, where the atmospheric pressure is very great, they say they cannot work over three hours, with intervals of rest between. The schedule of prices and hours of labor as prepared by the union are as follows: From 55 to 70 feet depth, $2.75 for six hours' work; from 70 to 80 feet depth, $3 and four hours' work; from 80 to 90 feet depth, $3.25 and two hours' work; from 90 to 100 feet depth, $3.50 and one hour and twenty minutes' work. For overtime they will charge double rates.

Japan, according to a recent statement, had 2,950 miles of government and private railways at the end of 1896, while charters had been granted for 1,548 miles, and applications for charters represented 12,351 miles more, says the Railway Age. This shows a possible total of about 16,800 miles, which, if built, would give an average of 11¼ miles of railway to each 100 square miles of the entire kingdom, or considerably more than twice the present average for the United States. Projection is very different from construction, as we in this country know, but that nearly 14,000 miles of additional railway are even contemplated in the little empire of Japan, the estimated cost of which would be about $355,000,000, is suggestive of the great possibilities of the future. At the same time let no American railway man engage passage for Japan on the strength of these statements.

The work of track elevation in the city of Chicago is receiving more attention at present than for some time past. Besides the work of the Chicago & Northwestern and the Pittsburg, Fort Wayne & Chicago Railways, noted in Engineering News of May 20, the notorious Sixteenth Street crossing has just been ordered abolished by the city council. This work will require the elevation of the tracks of the St. Charles Air Line and four other railways and the depression of the tracks of the Chicago & Western Indiana and Atchison, Topeka & Santa Fe Railways, and will cost some $2,500,000. It is stated that the roads interested have signified their willingness to accept the ordinance and that the beginning of work may be expected at an early date. The character of the construction will resemble in a general way that of previous track elevation work in Chicago, which has been described in Engineering News of August 20, 1896, and numerous previous issues. The Sixteenth Street crossing has always been considered one of the most dangerous grade crossings in Chicago, and the prospect of its early removal is unusually gratifying.

The experimental tank which is to be constructed at Washington by the Navy department for trials with models of new ships will be the largest basin of its kind under cover in the world, says the Marine Review. Its dimensions will closely approach those of some of the largest dry docks, and the depth will be sufficient to float many of the smaller ships of the navy. On all sides it will be covered, and the water will be supplied by the city reservoirs or pumped from the Potomac River. From end to end the tank will be just 500 ft. long and 50 ft. across, and inside the water space will be 475 by 43 ft. Its depth will be 14 ft. Running across, close to the water, will be a carriage upon which there will be attached a dynamometer to register the resistance due to towing a model through the basin. Models varying in size from 10 to 20 ft., of every new ship to be built, will be attached to this machinery and drawn through the water. The wave motion will be observed and the resistance it offers will be calculated. The models will be plain affairs, constructed only with a view to presenting closely the actual lines of a ship it is proposed to build. Through the experiments it is estimated that the plans of all proposed vessels can be improved and valuable information gathered for use in designing the lines of ships. The cost of the tank will be $100,000.

The Southern Pacific Railway Company is preparing to adopt schedules of tonnage rating for its goods locomotives throughout the whole of its lines, the plan having been in use with satisfactory results on the Western Division for two or three months. According to the Railroad Gazette, experiments are now being made, and in order to secure uniformity on the widely separated divisions of the company—some in Texas and some in Oregon—the general manager has issued to the fifteen superintendents of the company a circular outlining the plan adopted on the Western Division. A train of loaded cars is made up, with a list showing the weight of one car, of the first two cars, the first three cars, etc., and this is supplemented by a list beginning at the rear end. Weights are shown in "M's" or units of 1,000 lb. This train is tested on a level or on an easy grade, with one of each class of locomotives in use on that division, and then with a locomotive of one class only, it is tested on the ruling grades. In these last tests an engine facing backward is attached to the rear end of the train, to attach and detach cars where necessary, to act as a helper where needed, and to act as the hauling engine where grades are tested both sides of summits. Tests are being made, both starting from a standstill and in the usual way, up grades at ordinary speeds.

ELECTRICAL NOTES.

An electric tramway has been projected for the Principality of Monaco, and has been definitely declared "of public utility" by a royal ordinance. The work has been intrusted to M. Henri Crovetto.

The new Huron Street lift bridge over the Milwaukee River at Milwaukee, Wis., is operated by a 24 horse power electric motor running at a normal speed of 450 revolutions per minute and geared to a train which operates the working struts.

The Electrical Review understands that the Rogers printing telegraph system is to have a thirty-day practical test on the lines of the New York Central Railroad between New York and Albany. This system prints the message directly at the receiving station.

The extent of the business of the Bell telephone companies is shown in the following extract from the American Bell Telephone Company's last annual report: "The companies operating under our licenses expended during the year $8,275,920.11 for new construction, to which amount is to be added an expenditure of $1,160,931.30 for land and buildings." This makes the round sum of over $9,400,000 expended in improvements in twelve months.

According to the Detroit Evening News, the extraordinary spectacle of a fountain of water springing from the top of an electric tramway pole has been witnessed in that city. It naturally drew a crowd who looked on with amazement. When a gang of men were set to work to discover the occasion of the phenomenon, in the course of time they came to a water pipe which ran beneath the pole. This had been eaten through with electrolysis, and the water burst through, entered the hollow iron trolley pole, and having nowhere else to go, came out at the top. Electrolysis trouble is usually ascribable to insufficient rail return. It is believed that such a pretty demonstration of the necessity of looking out also for bad work or accident in the insulation of the trolley line is unique.

Dr. Julius Precht, of Heidelberg, has, says Nature, just published an important thesis on cathode rays, Roentgen rays, and other radiations emanating from vacuum tubes, which confirms the view that these rays are of a highly complex nature. Besides the rays capable of being deflected by a magnet according to the law of Biot and Savart (which the author has verified by photography), Roentgen's, Goldstein's, and Lenard's rays are shown to be distinguishable by their chemical and photographic effects. Dr. Precht considers that a portion of the radiation from a discharge tube is not a wave motion, because the absorption of the rays in passing through paper varies with the time of duration of the radiation; it is suggested that this portion may be electric in its nature. Interference phenomena were obtained with direct and reflected Roentgen rays, and from these their wave length was found to range from 370×10^{-8} to 800×10^{-8} mm.; and observing that transverse light waves of this length cannot pass through black paper, the author seems to incline to the theory of longitudinal waves. By such interference experiments wave lengths were obtained nearly twice and four times as great as those found by Voller in observing the diffraction produced through a slit.

A system for lighting, heating, and ventilating railway cars by electricity has been given a practical test by the Pullman Company, and it has been highly commended. The mechanism of the apparatus is very simple. A plain gear wheel is attached to the car axle, connecting by ordinary cogs with the shaft of a one horse power dynamo which is securely placed on the car truck. By this means a constant and reliable electric current is generated, which is passed through a small storage battery, whereby the light is rendered brilliant and uniform, both while the train is running and when it is standing still. Each car is thus independently provided with its generating and illuminating apparatus, so that cars may be detached from through trains, when desirable, and sent over connecting roads without limitation. All the mechanism is securely placed beneath the floor of the car, completely incased to avoid dust and dirt. The apparatus weighs less than five hundred pounds, and is automatic in operation, thus requiring no personal attention, except at long intervals of time, when regularly inspected at terminal stations. The mechanism is plain, simple, strong and permanent in character, and not liable to suffer from friction or depreciation, and the many difficulties which have heretofore embarrassed the use of electricity for car lighting are wholly and effectually solved by its use.

Testing Alloys with Roentgen Rays.—The following new use for the X rays was indicated in a recent lecture in England by Mr. Heycock, as reported in The Electrician: "The lecturer," it says, "drew attention to the fact that the composition of metallic alloys is and always has been a vexed question, that is to say, it has always been very doubtful whether the metals which compose the alloys form a homogeneous mixture or whether they exist as small distinct particles which are capable of being separated from one another. Now, some metals, such as sodium, permit of the passage through them of Roentgen rays, while others, such as gold, prove to be quite opaque when submitted to the radiation from a Crookes tube. Having made an alloy of sodium and gold, containing a very small percentage of the latter metal, he allowed it to cool very slowly, just as the solution of potassium permanganate in water had cooled. When cold a very thin section was cut, which was then radiographed. The radiograph revealed the fact that the sodium had crystallized out from the general mass. This is one of the most interesting results which have been brought about by means of X rays, and it opens up a wide field of research in microscopic photography which will probably enlighten us considerably with regard to the true nature of alloys. The atomic weight of sodium is 23 and that of gold is 197, so that sodium is roughly eight times more transparent to X rays than gold. The atomic weight of carbon, on the other hand, is 12, and that of iron is 56, so their transparencies are only as 5 to 1. However, the difference is sufficiently large to warrant the X ray research into the true nature of the various brands of steel and iron."

MISCELLANEOUS NOTES.

The citizens of Dijon, France, recently voted a sum of money for putting a railing round a tree standing within the city limits. The tree bears a label which informs the sightseer that it is the oldest poplar in France. The town council has a record tracing the history of the tree since the year 722 A. D. It is 122 ft. in height and 45 ft. in circumference at the base.

Prof. Hilgard, of the California State University, says that the Australian salt bush can be grown successfully on arid and alkali lands; that it removes from the soil large quantities of sodium carbonate and sodium chloride, the two most injurious alkaline salts. In soils, therefore, where the percentage of alkali is near the danger point they may be sensibly relieved by planting salt bush for several seasons. The yield is nearly equal to that of alfalfa.

An exchange says that "almost within the Arctic circle, in north latitude 63 to 70 degrees, Iceland, with its population of 70,000, is warmed on the west coast by the Gulf stream, and can raise fair hay crops and sparse root crops. About 65 per cent. of the population are occupied in rearing sheep and cattle, which are largely consumed at home, the first named exported in moderate numbers to British ports. Sheep are not shorn, but in early summer the fleeces loosen on the animal, and the loose wool is easily detached; most of the surplus goes to England."

The Stockholm Industrial and Art Exhibition was, in accordance with the original programme, solemnly opened by the King of Sweden on Saturday, May 15. The King and Queen of Sweden, the Crown Prince and Crown Princess of Denmark, with their daughters, the Crown Prince of Sweden, who is the president of the exhibition, and his three brothers were present. The king made an eloquent speech, and the opening ceremony was on the whole most auspicious. We shall in due course comment upon this interesting exhibition, at which the Swedish iron and steel industries are most adequately represented.

The Philadelphia Ledger says: "The scheme for a ship canal from Lake Erie to Pittsburg is said to have been killed by the new Carnegie Railroad, built to carry Lake Superior ore to the Pittsburg furnaces; but if this is true, there never was much need of the canal. Mr. Carnegie, it is further said, has arranged to use 5,000,000 tons of ore this year, practically all of which, besides a large amount of miscellaneous freight in connection with it, will be carried over his railroad and will probably take up most of its carrying capacity. If the canal was to be of use only to feed the Pittsburg furnaces, that was very little reason for building it. If it was to take a large amount of lake commerce to the Ohio, and thence to the Mississippi and the Gulf, the new railroad will scarcely supersede it. The scheme, however, may well remain in abeyance a few years longer; in time the increasing call for water carriers for heavy freight will demand the building not only of this canal, but of several others, many of which are already projected."

According to London Engineering, the profitable utilization of the great masses of waste glass accumulated at factories is accomplished in a comparatively easy manner by M. Garchey, a Frenchman. He grinds the waste glass and puts the powder into a metallic mould, which is introduced into two furnaces in succession, in order to devitrify the mass; the first furnace serves for the gradual annealing of the mass, so that all the parts are devitrified as uniformly as possible; the mould remains about one hour in this furnace. Becoming soft, the molecules weld together and form a very consistent dough. In this condition the mould is taken out of the furnace and put into a second furnace that is heated to a very high temperature. In this furnace the mould is left for only a very few minutes, this second operation being intended to complete the devitrification and to make the mass more pliable. The substance is now in a condition to be pressed into different shapes, there being produced in this manner all kinds of ornamental or other building "stone," which is generally called ceramic stone.

Favorable notice is given in the columns of Machinery of the new artificial fuel known as egette or ovoid, in distinction from the more familiar briquettes for that purpose. Special regard has characterized the efforts put forth in this industry by Europeans to produce a fuel as cheap as possible and suited, in the highest degree, for convenient handling, storage and transportation. In America, however, much greater attention has been given to the thorough preparation of the coal, also to the quality of the pitch or binding material used, and to that size of blocks which insures the greatest economy in manufacture and moving. The systems of preparing the coal for coking and briquetting, by washing and jigging, originated in Europe, and have been there long practiced to such an extent that, almost throughout the whole of the Continent, coke can be guaranteed to contain only a certain per cent. of ash. The thorough washing or freeing from all slate or other impurities is, of course, one of the chief factors in determining the value of the product, since the utility of such fuel depends mainly on freedom from ash, or the amount of available combustible matter it contains.

Some interesting data relating to the estimated comparative local cost of different pavements in respect of first cost, maintenance, scavenging and watering over a period of thirty years have been furnished in a report by the borough engineer of Wolverhampton, England. Granite sets on a bed of Portland cement concrete, 6 in. thick, cost $3 per square yard, and have a probable life of thirty years. Australian hardwood blocks on a bed of cement concrete, 6 in. thick, cost $4.50 per square yard, and have a probable life of eighteen years, while creosote deal blocks similarly laid require the expenditure of only $3 per square yard, with a correspondingly diminished life of twelve years. Natural rock asphalt pavement, 2 in. in thickness, on a bed of Portland cement concrete 6 in. thick, can be laid for $3.35 per square yard, the life being calculated at fifteen years. The total cost of each of the above mentioned pavements during thirty years for maintenance, scavenging and watering is fixed as follows: Granite sets for an area of 7,992 square yards, $45,000; Australian hardwood, same area, $87,210; creosote deal, $73,900; and natural rock asphalt, $63,175.

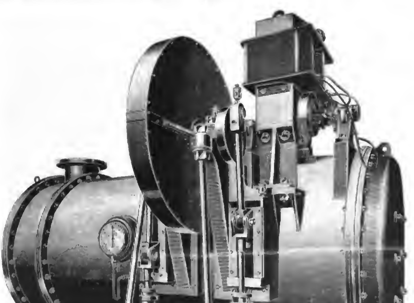
INDEPENDENT SURFACE CONDENSER.

In electric light stations the small auxiliary engines are a source of heavy additional expense and cost of working. The amount of steam used by them will vary from twice to six times the amount used per effective horse power when compared with large and more economical engines used for generating the electricity; moreover, these small engines will use nearly as much steam when the station is delivering only a small portion of its power as when it is working under its full night load. These small engines, moreover, owing to the smallness of their parts, often give considerable trouble in adjustment. To the air and circulating pumps illustrated below all these objections cannot be urged, for as they are electrically driven, the mechanical efficiency will be higher than that of the steam engines which are generally used to drive such pumps, and the power being received from the higher class engines of the station would be produced from them more cheaply than if independent engines were adopted.

The surface condenser illustrated is arranged with sufficient cooling surface to condense about 30,000 lb. of steam per hour, and is of the usual construction. The air pumps have been made self-contained with the condenser, the whole being bolted to brackets cast on the condenser body. The air pumps are driven by crank disks, with the pins placed on opposite centers, so that the weights of one pump will balance the weights of the other. The pumps are single acting, and produce a fairly even distribution of power. The air pumps are of the close top type, arranged to deliver their water at a higher level than themselves. On the shaft which carries these crank disks a heavy solid disk spur wheel is mounted, having machine cut teeth. This wheel receives its motion from the pinion mounted on the end of the motor shaft. The motor is a shunt wound machine, having a normal speed of 1,000 revolutions per minute, and receives its current from a 250 volt circuit. In order that the capacity of the air pump may be varied to suit the load on the station, resistances have been provided, so that the speed can be reduced in six stages to 375 revolutions per minute.

The centrifugal pumps illustrated below have 9 inch deliveries, and each is capable of delivering about 12,500 gallons per minute. As will be noticed, these pumps are driven from the opposite ends of the motor shaft, one pump being driven by a flexible coupling and the other by a friction coupling. During the day, and when the load on the station is light, it is intended that one pump only should be used, and as the load on the station increases the other pump is put in motion by means of the friction clutch. As the length of pipes in the station for which these pumps have been made is fairly long, to make the capacity of the two pumps twice that of the one it has been found necessary to compound wind the motor in such a way that when the second pump is started the speed will be slightly accelerated. The compound winding also possesses another advantage—that in case an attendant should too suddenly throw the clutch into gear, causing a heavy strain to be momentarily put on to the motor, while increasing the velocity of the water in the pipes, the motor would lag, gradually coming back to its intended speed as it was able to put the water into motion. The normal speed of these pumps is about 420 revolutions, and they also are arranged to work on a 250 volt circuit. The condenser, air and circulating pumps, and motor have been constructed for the Bradford Corporation New Electricity Works, under the supervision of Mr. A. H. Gibbings, the borough electrical engineer.—Engineer.

THE BUSHBURY ELECTRIC DOG CART.



INDEPENDENT SURFACE CONDENSER.

THE ENGINEER MOTOR CAR COMPETITION AT THE CRYSTAL PALACE, LONDON.

Everyone who is interested in the development of the horseless carriage or motor car—and who is not—will be greatly disappointed that the generous and laudable attempt of The Engineer, of London, to stimulate the youthful industry by the offer of an eleven hundred guinea prize for the best motor car should have ended in an inglorious failure. The competition was first suggested by our contemporary about two years ago, and shortly afterward the scope of the competition, its aims, and the conditions governing the exhibitors were published in full. It was announced that prizes would be awarded for the encouragement of manufacturers and designers of horseless carriages.

The objects of the competition were stated to be strictly utilitarian, The Engineer believing that an important trade might be created in this class of machinery, and that the removal of the restrictions on the use of mechanically propelled vehicles would result in great benefit to the farmers.

The date of the trial was originally fixed for October, 1896. As the time approached, it was found that the motor cars which were to enter the competition could not be completed in time, and a postponement was made to June, 1897. Seventy-two entries in all were received, and as the day drew near there was another request for a postponement, the period of delay asked for varying between one month and a year. This The Engineer did not grant; and when the judges, Sir F. Bramwell, Mr. Aspinall, and Dr Hopkinson, appeared on the scene at the appointed hour, there were only seven out of the seventy-two applicants on the ground, and of these only five were ready to take part in the contest.

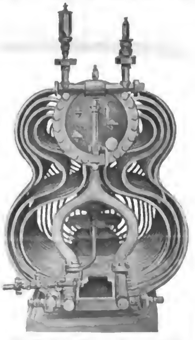
Our contemporary has this to say in the course of a pessimistic editorial:

"The end of it all is very dissatisfying and disheartening; only five vehicles appeared at the last for the competition, and 'the judges have decided that they cannot award a prize to any of the cars exhibited. It will therefore not be necessary for the trial run to Birmingham to take place. Although the judges cannot see their way to award any prizes, the steam car of the Liquid Fuel Engineering Company, and the Bushbury electric car of the Electric Construction Company, are highly commended.' This adverse decision, yet more unsatisfactory to us than to the competitors, was only arrived at after a most painstaking and exhaustive investigation by the judges. On Friday Mr. Aspinall spent some hours at the Crystal Palace examining the cars. On Monday Mr. Aspinall, first, then Dr. Hopkinson, and finally, Sir F. Bramwell, examined and tested the cars in the Palace grounds. Their verdict was only pronounced late in the evening after mature deliberation, and we venture to say none of the competitors will feel disposed to quarrel with the soundness of the decision, however much they may regret it.

"One result of our essay has been satisfactory. It has cleared the air. It has placed the world in possession of facts concerning the motor car industry in this country. There is at present no such industry. There is no such thing as a thoroughly satisfactory self-propelled vehicle. If a motor car of the kind existed, it would have been submitted for competition. We have received dozens of applications to postpone the trial. The period of delay asked for varied between one month and one year. It will be remembered that several months have elapsed since the world was assured that the construction of motor cars was a flourishing industry. Already we had put off the date of trial from October, 1896, to June, 1897. We have to deal with things as we find them. We have every reason to believe that the best that England can do at present was shown at the Crystal Palace on Monday; and, in the opinion of three most competent engineers, the carriages shown were so imperfect, so unsuitable to the fulfillment of the purposes which a motor car ought to serve, that they would not submit them to further trial. Administering the funds placed at their disposal to award as prizes, the judges have held that none of the vehicles so nearly satisfied the conditions with which a self-propelled motor car must comply that it was entitled to the final and crucial test of a long run. As we interpret this decision, it means that even if any of the cars had run to Birmingham and back within the prescribed period, that fact alone would not have compensated for its defects."

Although The Engineer is undoubtedly right in con-

cluding that, according to its own standard of what goes to make a successful motor car, there is no motor car industry in England, the statement is only true when taken in this limited sense. For it must be remembered that all vehicles propelled by light oil or petroleum spirit were at first rightly excluded from the competition. It is true that subsequently an offer was made of a five hundred dollar prize for vehicles using light oil; but, in view of the hostile attitude which has

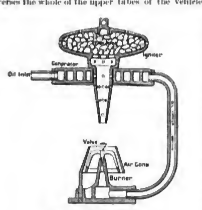


MOTOR CAR BOILER, LIQUID FUEL ENGINEERING COMPANY.

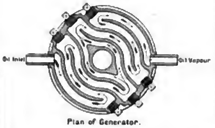
characterized The Engineer in reference to such motors, it is not surprising that they failed to put in an appearance at the trial.

We reproduce from our contemporary the accompanying illustrations and details of competing cars. The five vehicles included a four seat petro-car and a petro-cycle, sent by Messrs. Roots & Venables; a steam van by the Liquid Fuel Engineering Company, of the Isle of Wight; the Bushbury electric cart by the Electric Construction Company, of Wolverhampton; a light oil car by Mr. Cornell, and a car by the Yeovil Motor Car and Cycle Company.

The Roots & Venables cars, classes A, B, and D, represent most praiseworthy attempts to construct heavy oil engine motor cars. The first is thus described: The motor, which is twin cylinder, is of 3·2 brake horse power and runs at about 510 revolutions per minute. A silent running chain connects the crank shaft to a countershaft on which are keyed the friction clutches. These clutches drive either of two chain wheels, which are connected by chains and chain wheels directly to the axle. The cranks of the motor are placed opposite each other, so that one piston and crank balances the other, which it effectually does. The inventors' method of governing, by operating the exhaust valve and the oil feeder simultaneously and by the same mechanism, enables them, they say, "to obtain a clean exhaust, and the construction of parts surrounding the vaporizer and igniter relatively to one another insures complete combustion." The method of governing was only arrived at after many years of experiment. Their automatic burner for heating the ignition tube enables the motor to run continuously as long as it is supplied with oil, without any attention whatever, which they think cannot be claimed for any other oil motor, whether for vehicles or other purposes. The water is pumped through the jacket; it then traverses the whole of the upper tubes of the vehicle



SECTION OF BURNER



Plan of Generator.

frame and then by half the lower tube to the water tank, thence by the other side of the lower tube of the frame back to the pump. This enables a much less quantity of water to be carried.

There is only one countershaft, which not only drives the main axle directly, but also operates the valves and carries the governor. The inventors say that they have found by experiment that it is advisable to have the driving countershaft directly over the axle rather than placed horizontally with it, and to have an intermediate stiff spring for various reasons, three of which are as follows: (1) In meeting with a large obstacle, such as a brick, the driving wheel, if the car is going at a slow speed with but little momentum, is suddenly checked, and the chain may snap or shear a tooth off the wheel; in this car the chain slackens to reduce the jar; (2) slack in the chain is easily taken up, and the chain can always be kept tight; (3) the chain runs more smoothly, and the power is conveyed through the clutches more evenly and steadily, with less "grips and slips." The steering of the car can be done at full or slow speed with the finger and thumb, and is always positive. No gear wheels are used anywhere in the motor or car, all driving is done by chains to obtain silence.

The Roots petro-cycle carries two persons, the rear one steering and driving. There are three wheels, two in front and one, the driver, at the back. The wheels are fitted with solid rubber tires. A cross bar, connected by links to the two front wheel heads, steers both wheels at the same time. The motor is of $1\frac{1}{2}$ brake horse power and runs at about 510 revolutions per minute. A silent running chain connects the crank shaft to a countershaft, which is connected by a chain to a second countershaft, on which is fitted a friction clutch. This clutch drives either of two chain wheels, which drive the spindle of the back wheel by chains. The water tank is placed on one side of the frame to balance the fly wheel on the other. The cooling water is conveyed from the tank through the tubular frame of the car and passes through a coil of pipe surrounding the fly wheel, and is thus cooled by the air given off at the periphery by rotation. The ignition tube is first heated by a separate lamp, which is removed or extinguished as soon as the engine is started. The tube is afterward kept hot by means of an automatic burner. The attention of the judges was especially drawn to: 1, The tubular frame for conveying and cooling the jacket water; 2, the coil round the fly wheel for cooling the jacket water; 3, the automatic burner; 4, balancing the fly wheel by the water tank; 5, making the same governor govern both the oil feed and the exhaust valve; 6, doing without the use of gear wheels at all, either in the car or motor; 7, the construction of the ignition tube relatively to the port and combustion space, enabling a complete combustion to be obtained. It would be quite impossible to make the special features of these cars intelligible without drawings, which, for the reasons we have given, we do not publish.

The Yeovil motor car, class B, is a light business carriage for two persons. It is driven by a two-cylinder Petter patent petroleum engine, working on the Otto cycle and using ordinary petroleum, such as the American brand of "Royal Daylight." The cylinders are arranged side by side and fire alternately. The explosions are effected by means of two ignition tubes heated by a single blow lamp. The air inlet valves of the motor are operated by the suction of the piston, the exhaust valves by means of levers driven by chain gearing from the crank shaft. The motion is taken from the crank shaft to an intermediate shaft by means of sprocket wheels and chains, reducing the speed in the ratio of 2·8 to 1. A friction disk on the intermediate shaft is made to grip the chain wheel by lateral pressure applied to the end of the shaft by a hand lever. The intermediate shaft drives on to the rear axle by either one of two chains, the one gearing in a ratio of 12 to 32 and the other of 6 to 36, providing fast and slow speeds of ten and four miles respectively. A square clutch on the intermediate shaft between these two chains throws either one of them into action. The rear axle drives only one of the rear wheels of the carriage. The patent reversing motion is taken from the crank shaft by a belt. This belt drives a loose pulley carried on a foot lever. When reversing, the friction clutch for forward driving is released, the foot lever is held down and the back of the belt pressed on to a pulley fixed on the intermediate shaft. A brake is held on the fly wheel by a spring to control the engine when the carriage is at rest. When the carriage is in motion this brake is held off by a hand lever. Two pairs of ordinary carriage brakes are applied to the rear wheels, and the reversing motions provide a strong additional brake in case of emergency.

The Electric Construction Company's dog cart, class B, is designed to carry two persons seated side by side. The motive power is derived from accumulators, and the motor is at rest when the car is standing. It can travel up to 12 miles an hour on a good level macadamized road, and has surmounted gradients of 1 in 14 at a walking pace. It is not claimed that the accumulators will carry it under average conditions more than twenty miles without recharging. It can be made to travel backward at a walking pace. Its weight is about $13\frac{1}{2}$ cwt., exclusive of passengers. There are two driving wheels, and one steering wheel in front. The two pole motor is geared by means of a Renold chain to the driving axle. The driving wheels are keyed to the axle, which is divided into two parts, united midway between the wheels by an ordinary bevel wheel differential gear, to the case of which the sprocket wheel is attached. The steering wheel is mounted in a fork, and the backbone is pivoted on it by a joint having universal motion. Diagonal side braces are attached by joints to the lower extremities of the fork, and at their other ends to the front of the cart; these keep the fork in position, and permit of the wheel locking; they also cause the wheel when locked to be deflected from the perpendicular toward the side of the greater circle described, thus greatly adding to the stability when turning.

The steering wheel is guided by leather reins, running through eyes in a cross bar attached to the top of the fork. A bolt is provided, by which the wheel is kept in mid position; this is released automatically when tension is applied to the reins. The switch gear consists of a reversing and a controlling switch, placed under the driver's seat; the former is manipulated by a vertical lever on his right hand, the latter has four positions: (1) Off; (2) two parallels of twenty cells in series, in circuit with the motor; (3) forty cells in series, in circuit with the motor; (4) forty cells in series, in circuit with the motor, with a resistance in parallel with the magnets. The controlling switch is a roller actuated by the driver sliding his seat forward when starting or accelerating the motion, and sliding it backward when slackening the speed or cutting off the current. When the controlling switch is in the first position and the car is running, if the reversing switch be set to backward, the motor is closed on itself in circuit with a resistance and generates current. This combination is chiefly of use in checking the speed of the cart on long descents. For bringing the cart to a stand, a band, actuated by the foot, is applied to a cast iron drum on the motor axle.

The motor is carried by a frame, articulated at one end to the road axle bearing cases and at the other end slung by an elastic attachment to the under side of the foot board. In working, the distance between the motor and road axles is fixed, but it can be adjusted to compensate for wear in the chain. The driving wheels are 39 in. diameter and the steering wheel 45 in.; they are of steel throughout, with solid rubber tires. All three wheels are fitted with ball bearings. The sprocket wheel is $20\frac{1}{2}$ in. diameter; the chain is $\frac{5}{8}$ in. pitch and has a breaking strain of over 600 lb. About

ROOTS & VENABLES PETRO-CAR.

three-fourths of the weight is carried on ordinary elliptical carriage springs, resting on the bearings of the driving axle, the rest of the weight is carried by the front wheel. The gage is 4 ft. 6 in. and wheel base 5 ft. 6 in. All the working parts are boxed in, but are easily accessible from above. The motor bearings receive continuous lubrication from an endless chain dipping into a reservoir of oil. The motor is series wound and has a slotted armature, drum wound, with Eickemeyer coils, and carbon brushes are used. The magnet is two pole, wound with a single coil of square wire. The commercial efficiency is about 80 per cent., with 80 volts 10 amperes, at 700 revolutions per minute, this output approximately corresponding to a speed of ten miles an hour.

The accumulators are of the Faure-King type, manufactured by the Electrical Power Storage Company, Limited. There are four boxes, each containing ten cells, the total weight being about 5 cwt. Each cell consists of two half plate negatives and one positive. The rated capacity is 40 ampere hours at a discharge rate of 5 amperes, or about 28 ampere hours at a discharge rate of 15 amperes. The accumulators are carried in the body of the car, and terminals are provided for charging them in place, for which current at 100 volts is required. They are completely discharged when the volts drop to 74, and then require about seven hours to recharge. The depth of the boxes and cells is such that violent jolting does not cause the acid to be spilt.

By far the most interesting vehicle shown was the Liquid Fuel Company's van, class C. This company has been engaged for some time in the construction of launches and small yachts, some of these indicating about 200 horse power. Steam is generated in a water tube boiler, the fuel used being petroleum. The application of this boiler and furnace to road locomotion is a new departure on the part of the firm.

About two-thirds of the length of the van inside are available for passengers or goods. Under the floor are placed a pair of horizontal tandem compound engines. These are so small that they resemble models. They are beautifully made, and running at 625 revolutions per minute, with a pressure of 250 lb. they give about 12 brake horse power. The crank shaft is geared about 2 to 1 to a countershaft, which is geared about 4 to 1 on the road wheels. Thus the carriage wheels make one revolution for about 8¼ revolutions of the crank shaft. Under the driver's seat, which extends across the front of the van, is a box, the seat forming the lid. In the box are two horizontal plunger feed pumps, driven by an inclined shaft and bevel gear from the first countershaft. One of these pumps is spare. There is, besides, in the box a little horizontal double acting steam donkey pump, for feeding the boiler when the van is standing. The driving wheels are turned round by toothed wheels of good size secured to the wood spokes. These wheels are inclosed in cases, so made that it is claimed that no dirt can get in. The engine, and all the gearing, indeed every portion of the mechanism, is readily accessible, all the arrangements having been carefully studied and worked out on lines which commend themselves at once to the professional eye.

Steam is generated in a tubulous boiler, a sectional view of which is given in the accompanying engraving. The drawing explains itself to any one who has ever seen a water tube boiler of the Thornycroft or Normand type. The tubes of solid drawn copper are not rolled in, but are fixed by a patented screwed joint. The ends of the tubes are flanged after running nuts have been put on them, and these nuts are then used to force home the tube ends, copper to copper, and to make a joint; the boiler stands across the car, just behind the front seat. The water tanks serve as two longitudinal seats in the van. The steam drum is of Elmore deposited copper, and any tube may be taken out and replaced in a very short time. The arrangement for burning the petroleum is very ingenious and highly satisfactory, and will, we think, be readily understood from the accompanying engravings. The oil is delivered into a "gaseller" over the flame, which serves to spread the flames and hot air. The oil is driven into this gaseller by the pressure of air maintained over its surface in the tank by a small pump worked by a handle at the driver's right hand. The petroleum vapor thus produced passes down through a pipe as shown to a conical burner, and the amount which issues is regulated by a tapered pin, the position of which is controlled automatically by the boiler pressure. The combustion produced is very complete, and the boiler made at all times as much steam as the engines could use.

LIGHTING AMERICAN CITIES.

THE cost of street lighting in New York City for the year 1897 will be in excess of $1,250,000. The specific appropriation for this item is $1,222,821, to which are to be added sundries, which will probably bring it up to the total named, says the New York Sun. Philadelphia spends even more than does the city of New York in a year for lighting its streets and alleyways, the total expense being $420,000 for gas and $947,000 this year for electricity. These items collectively do not foot up to so much as New York pays, but while New York gets its supply of gas from seven different companies, and its electricity for lighting from ten different companies, Philadelphia owns its own gas plant, and since 1855 has had entire control of it. To the money actually disbursed for gas, therefore, must be added in the case of Philadelphia a reasonable interest upon the original investment, and some account must be made of the public property used for the works.

Chicago expends in a year $125,000 for gas lamps which illumine with indistinctness some of her streets, the major portion of which are unpaved roads separated from the buildings which front them by wooden sidewalks resting in the mud. Boston is an American city which, in proportion to its population and area, makes generous provision for public illumination. Boston spends in a year $290,000 for gas and $270,000 for electric lighting, a total of $560,000, the extent of which may be best understood by comparison with the expenditures for the like purpose in Baltimore, a city of the same population, practically, and of about the same area. Baltimore spends in a year $220,000 for gas and $140,000 for electric current. Cincinnati spends in a year $200,000 for gas and $75,000 for electric lighting. The area of Cincinnati is about the same as that of Boston, and about one-half of the present area of New York, Wakefield and the Bronx Valley villages included. It is a fact, not known to some of the most zealous and ardent of the Good Government Club reformers, that the annexed villages on the Bronx are lighted with neither gas nor electricity, but with naphtha lamps. These lamps are not expensive; neither is the naphtha used in them, but the distance between lamps is such that the traveling expenses or mileage of those intrusted with the task of communicating flame to the wicks is a considerable item of expense.

San Francisco expends in a year $300,000 for public illumination, both gas and electricity, and St. Louis a like amount. In Pittsburg the advantages of natural gas have been utilized of late years, and the expense for public illumination is $250,000. In Brooklyn it is $520,000—$160,000 for gas and $360,000 for electric current. Washington, the local affairs of which are under control of the Federal government and subject to acts of Congress, spends in a year for electric lighting $175,000. St. Paul, Minn., expends as much, and New Orleans, $225,000. Two American cities which show a distinct partiality for electricity as a means of public illumination are Denver and Detroit, and there are, practically, no cities which have not utilized, to some extent, the benefits of electricity. Buffalo expends in a year $300,000 for purposes of illumination, and as the area of the city is small, it should be one of the best lighted of American cities.

THE PREVENTION AND REMOVAL OF SMELLS.*

By FREDERICK R. GREEN, Ph.G., Muscatine, Iowa.

PREVENTION of Decay.—Evil odors are equally penetrating with sweet smells. They diffuse themselves through the air and affect the senses unpleasantly, even when the absolute quantity of matter present is too minute to be detected by our most refined methods of chemical analysis. Unlike the sweet odors, however, they are produced everywhere around us, and are, therefore, a universal source of more or less perceptible irritation and annoyance. To prevent the introduction of evil smelling substances into the atmosphere which surrounds us, and, when present, to remove them, has consequently been at all times an object of desire. The attainment of this desire has been rendered both more easy and more perfect by the discoveries of modern chemistry.

The smells which usually arise from the decomposition or decay of the bodies and droppings of animals can often be either arrested or altogether prevented. Extreme cold, for example, such as is sufficient to freeze and harden the dead body of an animal, will preserve it in a state of absolute freshness, even for thousands of years. In northern climates the freezing of flesh and fish is the common way of preserving it; and in the ice cliffs on the banks of a Siberian river the entire body of an extinct species of elephant has been met with, so little decayed as to be still greedily devoured by dogs. Even moderate cold, if accompanied by a dry wind, will prevent decomposition, the former retarding the decay till the latter removes the moisture which is necessary to its continuance. The cargoes of fresh meat brought from distant countries are kept unchanged by means of cold. The heat in the meat chambers of such a vessel is withdrawn by means of the evaporation of very volatile liquids, such as condensed sulphurous acid gas, ether, or liquid ammonia. These liquids in being vaporized absorb heat and so produce cold. Or the total exclusion of air will have the same effect, as is seen in the tinned meats, now so useful, not only in long voyages and in remote parts of the earth, but for bringing cheap and excellent supplies of animal food to our shores.

Decay can also be prevented by the direct application of chemical substances. This is done when fresh meat is immersed in sugar, or when it is impregnated with common salt or with a mixture of common salt and saltpeter. These substances fill the pores of the flesh and thus preserve it by excluding the air. And they withdraw the moisture of the flesh and render the latter less favorable to the development of those minute organisms, both animal and vegetable, which incite and increase decay. Volatile tarry matters, such as creosote and carbolic acid, which are contained in the smoke from peat and coal, in wood vinegar and in the spirit which is distilled from coal or wood tars, act in a similar way. They combine with the fiber of flesh or fish and retard its decay, until the removal of moisture by evaporation renders decay both slow and difficult. It is in this way that the smoking of fish or flesh contributes to a speedy cure, saving both time and salt, rendering the cure more certain and adding at the same time an artificial flavor which to many is very grateful.

Charcoal, when recently burnt, has much efficacy in preventing the offensiveness of animal decay from becoming sensible to the smell. Sprinkled in the state of powder over the parts of dead animals, it preserves them sweet for a length of time. Placed in pieces beneath the wings of a fowl, it keeps away much longer than usual any appearance of taint. Or, if strewn over substances already tainted, or mixed with liquids which have acquired the unpleasant smell of decaying organic matter, it removes the evil odor and makes them sweet again.

The Disguising of Smells.—Where evil smelling decay of any kind commences, or where volatile substances which disagreeably affect the organ of smell escape into the air from any source, we naturally desire to rid ourselves of the unpleasant sensation. This we generally wish, and always ought, if possible, to do by removing the substance to which the noisome smell is owing. In the great majority of cases, however, we merely overpower or disguise it. We are content to mingle with the smell we dislike some odor we can enjoy, and to leave floating in the air around us the evil and the good together, to produce unheeded their natural effects upon the system.

Sweet odors are thus the natural disguisers of evil smells. They are the only resource of rude and dirty times against offensive emanations from decaying animal and vegetable substances, from undrained and untidy dwellings, from unclean clothes, from ill washed skins and from ill washed stomachs. The scented handkerchief in these circumstances takes the place of the sponge and the shower bath; the pastile hides the want of ventilation; the attar of roses seems to render the scavenger unnecessary; and a sprinkling of musk sets all other stinks and smells at defiance. The "sixty stinks of Cologne" may thus be at once the parent and grand consumer of its artificial rivers of scented water. The fiercest demand for the luxury of civilized perfumes may exist where the disregard for healthy cleanliness is the greatest. Even the burning of incense at the altar may find a merely rational use in disguising the dank and unwholesome smells which damp walls and floors engender, and in hiding from the senses of the worshiper the noxious effluvia which slowly decaying bodies in hidden vaults are continually giving off.

The Removal of Smells.—The absolute removal from the air—at least from a limited portion of it—is not a difficult task. The substances by which this is effected are known in modern sanitary language by the name of deodorizers.

Of these deodorizers, or smell removers, charcoal in its various forms is one of the cheapest, most abundant and most efficacious. Mixed with fermenting night soil or with the contents of our common sewers, it sweetens them almost immediately, and it produces a like effect upon almost every variety of decaying animal and vegetable matter. Spread to the depth of two or three inches over a festering graveyard, or even over a decaying dead body, it is said to prevent any evil odors from rising into the air or becoming sensible to the smell.

Animal charcoal, such as is produced by the charring of animal substances out of contact with the air; peat charcoal, seaweed charcoal, and the black powder produced by charring together a mixture of earth and vegetable matter, are more efficient in the removal of smells than common wood charcoal, however finely it may be powdered. It is this power of absorbing evil odors which strongly recommends the different kinds of charcoal to the sanitarian for removing the smells of graveyards, cesspools, drains and other places where filth has been permitted to accumulate.

This remarkable action of charcoal is due to three properties: First, its remarkable porosity. In consequence of this it absorbs gaseous substances in large quantity and condenses them in its pores. Second, the special affinity which charcoal exhibits for certain strong smelling and coal burning substances. So powerful is this affinity that if a tablespoonful of finely powdered animal charcoal, or twice as much newly burned wood charcoal, be shaken up with a pint of stinking ditch water and the mixture filtered, the water will pass through bright, clear, and with little of either taste or smell. Third, the oxidizing influence it appears to exercise upon the substances it absorbs. Many of these substances, whether gaseous or solid, whether strongly smelling or strongly coloring, as soon as they are laid hold of by the charcoal, begin to unite with oxygen, to lose their characteristic properties and to change into new chemical compounds.

Peat, if dry and in powder, acts also as an absorber of smells. It is likewise of an acid nature, which enables it to combine with and thus retain ammonia and many of the stinking substances it has absorbed. Earth rich in vegetable matter acts in a similar manner, and even some varieties of clay purify the water that filters through them. The porous matter obtained by burning together clay and vegetable matter under cover has powerful absorbing properties.

The Destruction of Smells.—Substances that absorb and remove evil smelling bodies do not necessarily destroy their smells or take away any poisonous quality they may possess. Thus water absorbs sulphureted hydrogen, but acquires, at the same time, its offensive smell and its poisonous property. Heat the impregnated water, and the gas escapes again into the air with all its original qualities. Bodies which act as water does in this case remove but do not change the smelling substances. But, if into water or air which smells of sulphureted hydrogen a little chlorin gas be introduced, the smell of rotten eggs will disappear almost instantaneously. The sulphureted hydrogen is decomposed and destroyed. It no longer exists, and consequently both its smell and poisonous influences are gone. Water, as regards sulphureted hydrogen, is a smell remover or deodorizer. Chlorin acts upon the same substance as a smell and poison destroyer or disinfectant.

This distinction is not without its practical importance. Water, soil and other absorbents may remove and retain noxious substances, so long as cold or wet weather continues, but let heat and drouth return, and forthwith from water and soil they steam up again more or less unchanged. Hence those reeking miasms which spread mortal fever and chattering ague over entire provinces.* The disinfectant decomposes and destroys the evil compound, so that no change of circumstances can bring it into activity again.

All disinfectants act chemically. They either decompose or they combine with the noxious substances and produce new compounds which, if not always void of smell, are comparatively harmless in their action upon the human body.

Nitric oxid gas is produced when nitric acid is poured over pieces of copper in a glass or earthenware vessel. As it rises into the air it combines with oxygen and water, and forms red fumes of a strongly acid nature, which diffuse themselves through the atmosphere. These fumes have a somewhat uncertain action upon the noxious substances, contaminating the air; moreover, they provoke cough, and cannot be breathed with safety, and they corrode nearly all metallic substances with which they come in contact.

Sulphurous acid gas is produced when sulphur is burned in the air. It is one of the offensive substances classed with mineral smells. In large quantity it is both noxious and offensive to breathe, but as a disinfectant it may often be used with advantage. Hence the very common practice of fumigating with burning sulphur, a sulphur pastille being one of the best and neatest forms of using this substance. The first effect of this gas when diffused through the air is to overpower all smells and thus to make them imperceptible;

* Western Druggist.

* The noxious paludal effluvia commonly are thought to be microbic, and not gaseous.—Ed. W. D.

it acts as a smell disguiser. Its next effect is chemically to decompose or destroy such offensive substances as the sulphureted and phosphureted hydrogens that pervade nature.

Hydrochloric acid gas is produced when sulphuric acid is poured upon common salt. It unites with the moisture of the air the moment it is disengaged, and forms white, strongly acid fumes, which provoke cough and cannot be breathed. These acid vapors will act upon and destroy many kinds of strong smelling and noxious gases and vapors which may be present in the air.

Chlorin gas is obtained when hydrochloric acid is poured upon finely powdered black oxid of manganese; or when this powdered oxid is mixed with the common salt before pouring sulphuric acid upon it, as in the preparation of hydrochloric acid gas above described. Chlorin is a heavy, greenish colored, suffocating and strongly smelling gas. It decomposes sulphureted hydrogen, phosphureted hydrogen, ammonia, and nearly all other gaseous compounds and evil smelling vapors which escape from decomposing vegetable and animal matter. It acts upon all organic substances almost without exception.

Chlorin has long been employed as a remover and destroyer of unpleasant smells. It is the most generally efficient for this purpose of any gaseous substance with which we are acquainted. It is further recommended by being easily and cheaply prepared and by producing its good effects even when so much diluted with the air as to be inhaled without injurious effects. It can thus be used within a building without displacing its occupants and with little inconvenience even in the chambers of delicate invalids.

Chlorid of lime possesses the chemical qualities of an efficient disinfectant in a high degree. It consists of lime and chlorin; of these the lime combines with acid bodies, while the chlorin either combines with or decomposes the alkali compounds represented by ammonia. And at the same time it possesses a remarkable power of oxidation; it burns up many of the offensive neutral bodies evoked during decay. It exerts this influence even upon sulphureted hydrogen. Spread in the solid form upon any fermenting mass, it destroys the noxious bodies as they are formed. Dissolved in water and sprinkled over bad smelling chambers, or mixed with more or less fluid collections of putrid matter, it brings sweetness everywhere.

THE STUDY OF CRIME AND DEGENERATION FROM A MEDICAL STANDPOINT.*

By WILLIS S. ANDERSON, M.D., Detroit, Mich.

MY object in presenting this paper is not to offer anything distinctly new or to favor any preconceived theory; but rather to bring together certain facts from various sources and to draw such conclusions as the facts would seem to warrant.

We must assume for the purpose of our study that mental acts have a physical basis.

Since the days of Ferrier, whose experiments confirmed the works of Fritsch and Hitzig, of Berlin, the localization of brain function has been well established. It has come gradually to be acknowledged, with the accumulated evidence derived from the study of the lower animals and man, both in health and disease, that all our mental acts have a physical basis, in the sense that mentality is accompanied by a chemical change and a structural rearrangement of the molecules of the nerve cells. Hodges, in the study of fatigue, found an actual change in the brain cells following activity, that disappeared after a period of rest.

There are some who do not believe in this newer physiology; but the evidence derived from competent observers seems to warrant us in accepting this doctrine as the most rational explanation. It was formerly believed that our passions, such as hatred, love, fear, and the like, as well as reason, were confined to man; but the study of the works of Romanes, Lubbock, Darwin, and many others, convinces us that these qualities are common to the lower animals.

It is now generally accepted that the mental acts of animals, children and adults differ not in kind, but only in degree; that the same laws that govern our minds govern those of animals; and that similar chemical and molecular changes take place in the brains of both men and animals. If these facts are true, the study of crime and degeneration has a new interest, and much can be gleaned from the psychological study of animals and man.

The study of criminals and degenerates has been mainly along two lines: first the somatic or bodily anomalies; second, the psychological peculiarities. Lombroso was the first scientist systematically to study the physical peculiarities of degenerates, and his tabulations of the various measurements of criminals and the insane form an interesting study.

It would seem from the study of the writing of the Italian school that abnormalities in general, and those of the head in particular, were more common in criminals than in normal individuals. The cephalic indices are greater, the prognathous jaw and the atypical or projecting ears more common than in the normal.

The committee appointed by the British Medical Association to investigate the development and condition of the mind among school children found that ear defects were frequently associated with nerve defects and mental weakness. Dr. Langdon Down finds a resemblance between feeble minded children and the various ethnic types of the human family, especially the Mongolian and Negroid.

However attractive statistics and measurements may be, we must not forget the importance of racial characteristics, the effect of diseases, both prenatal and postnatal, on the physical development of the individual. It is also important to remember that apparently normal persons may frequently have one or more of these degenerative marks. It would seem that one is justified in concluding, after taking all facts into consideration, and from the study of a large number of cases, that the criminal, the insane, the idiot, and the feeble minded have physical anomalies oftener and more highly developed than normal individuals.

The more recent studies of criminology have been along a psychological line, rather than by the observation of the purely physical anomalies. It is as impossible to define sharply the limits between a normal and an insane or a criminal person as it is to understand accurately the difference between the diseased and the healthy action of cells.

As Max Nordau says: "The difference between disease and health is not one of kind, but of quality. There is only one kind of vital activity of the cells and of the cell systems or organs. It is the same in disease and in health. It is sometimes accelerated and sometimes retarded, and when this deviation from the rule is detrimental to the ends of the whole organism, we call it disease."

So it may be said with criminals. It is impossible to define the limits separating normal from degenerate persons. All mental processes are governed by the same laws, and all of us have at some time in our existence criminal tendencies; but it is only when our evil propensities become detrimental to the community in which we live that we are considered criminal.

Let us consider the evolution of crime, in order that we may rid ourselves of the idea that those acts which we are accustomed to call criminal are confined to the human species. Animals low in the scale of life are prone to commit such criminal acts as infanticide, murder and thieving. Snakes very often devour their young. Lubbock cites instances where bees and ants kill those of other species for the purpose of robbery. Romanes, in his "Animal Intelligence," gives any number of instances of crime committed by animals. Speaking of a certain species of ants, he says, judging from experiments, it would seem that hatred was a stronger passion than affection, while in other species sympathy and affection seem to be more highly developed. Audubon is reported as having observed the thieving propensities of birds. Many species are habitual thieves and often secrete articles apparently of no value to themselves. The tendency to steal and to hide things is one of the strongest traits of the wolverine. Rats, mice, wolves, rabbits and birds have been seen to kill those of their own species. Dogs have been known to slip their collars, and go miles to kill sheep, then wash the blood from their bodies in a stream, return before daylight and slip on their collars. Monkeys many times will kill their young, when tired of carrying them. They are also fond of deception and are great thieves. Many animals develop uncontrollable passions, and while infuriated often kill those of their own species or even family.

While these facts and many others have been observed, it is true that the maternal instinct is highly developed in animals, and that affection is so strong in some that they will die for or in defense of their own species, and in some instances those of other species. Though some of the acts mentioned may have been done in self-defense or self-preservation, there are many apparently purposeless acts against the natural instincts of animals that may surely be classed as morbid.

Turning our attention to the uncivilized races of men, we find crime especially frequent. The primitive tribes, as a rule, place but little value on human life, especially on those of women and children. Wood, in his "History of the Uncivilized Races of the World," cites any number of instances to show the criminal tendencies of the savage. Some of their crimes are associated with their religious or superstitious beliefs; but many seem to be the natural result of unrestrained animal passions. I have been told by one living among our American Indians in Idaho that infanticide is common.

The study of childhood offers much that is of practical as well as of scientific interest. The psychology of children occupies a middle ground between that of the lower animals and the adult man. It may not be pleasant to some to associate our babies with the lower animals; but it is, nevertheless, true that a close study of human embryology and the psychology of childhood teaches us that there are definite relations between the workings of the animal and infant mind. An infant at birth has its animal instincts highly developed, and in gesture, mimicry, and instinctive movements bears a close resemblance to the monkey. As the minds of children gradually develop, those qualities which are prominent in criminals and degenerates are the first to evolve. The idea of self enters more largely into all their acts than in normal adults. The emotions of the child are more easily aroused and less under the control of the will than in later life. Attempts to injure those around them are very common during fits of anger. Petty thieving of tempting morsels, of playthings and of similar articles and the practice of lying are common, even among carefully trained children. Capital crimes are not unknown among children. Murder and assaults have been reported many times. Children have a very imperfect idea of ownership and responsibility. Deceit, vanity, pride, superstition and cruelty are common traits in early life. These qualities, so undesirable in adults, are usual in children; and an exaggeration of these very traits in criminals marks them as vicious members of the community.

Idiocy, feeble-mindedness and epilepsy are accompanied by mental impairment, and often lead to crime and acts of violence. These affections may be due to congenital defect, to injuries, or to disease. Emotional instability is common among criminals, and often develops while they are secluded in prison. They frequently have periodic explosions that resemble epilepsy and which, like that disease, are more frequent in hot weather. One observer states that four per cent. of the criminals under his care were subject to violent fits of passion; among women these attacks are more common during the menstrual period.

Lombroso has pointed out that those regions in Italy that produce the most epileptics also produce the largest number of criminals. The relation between insanity and crime is an important one, although too large a subject to be considered in a paper of this kind. Those crimes that lead most often to insanity are potent agents in the production of crime. For instance, syphilis, alcoholism and sexual excesses are responsible for much of our insanity and our crime.

Jacobi says: "The constitutional criminal is a tainted individual and has the same relation as the epileptic to convulsions. The essential reason of abnormal brain action is abnormal brain structure." Later he says: "There is no especial type of insanity or of criminality. There is but one thing fixed, that is, the relation of cause and effect, the correlation of physical causes and mental and moral symptoms."

Lombroso, in his "Men of Genius," and Nordau, in his "Degeneration," give any number of examples of excessive nervous and mental action in men and women who have been prominent in their respective fields of activity. While it is true that Nordau has exaggerated the condition, it is, nevertheless, a fact that the history of poetry, art, music and literature is filled with examples of men and women who bore distinct marks of degeneration. Many inherited insane tendencies, some succumbed by reason of disease, overwork or dissipation. According to one authority, insanity is forty times more frequent among criminal than among average men and women.

We can trace in all individuals a process of evolution in the building up of their natures. Animal instincts are highly developed at birth, next intellectual power is added, and finally moral and ethical conceptions help to round out a man's character.

That it is possible to have arrest of development during any stage is apparent, just as there may be arrest of development during the embryonic stage, leading to congenital anomalies. If the process of evolution is checked in early childhood, only the animal instincts exist, and idiots and imbeciles are the result. If the arrest takes place later, we have impaired mental power or feeble-mindedness. If the arrest or atrophy is postponed until manhood is reached, we may have intelligence, but no moral sense. There are in society to-day many moral imbeciles, whose intelligence disguises them from the world until they commit some heinous crime that reveals their true character to society.

Heredity exerts a marked influence in the production of criminals. Just as physical and mental peculiarities are transmitted from parent to offspring, so moral and criminal tendencies are likewise inherited by children of degenerate parents. Some would explain these apparent transmissions of criminal tendencies by environment, but after considering all points there seems to be no doubt that criminal tendencies are actually transmitted. We do not mean by hereditary transmissions of criminal tendencies that parents must have been actual criminals in a legal sense, or that the children are; but that the inebriate, the epileptic, the insane, the morally depraved, beget children that are deficient morally and are prone to drift into criminal life, without regard to environment.

The Jukes family, as studied by Dugdale, is an excellent illustration of the influence of heredity. From the head of the family, Max Jukes, a great drunkard, descended, in seventy-five years, 200 thieves and murderers, 280 invalids attacked by blindness, idiocy or consumption, 90 prostitutes and 300 children who died prematurely. Out of 700 descendants carefully studied, but few were honest. Of the men, not more than 20 were skilled workmen, and 10 of these learned their trade in prison.

It has been observed that criminality, like idiocy, tends to run in the line of the eldest sons. Morris gives instances where, for four generations, marks of degeneracy were plainly evident, and with the fourth generation the race became extinct. He also points out the tendency to degeneracy in children of intemperate parents.

It would be interesting to study more in detail the influence of such diseases as syphilis, tuberculosis, alcoholism and meningitis in the production of abnormal conduct. That these and many other affections are important can hardly be doubted after studying carefully the histories of many criminals, who, either by inheritance or from acquired disease, have dyscrasiae, which enfeeble them physically and render unstable their nervous systems. We must not infer from this study that criminals and degenerates can be arranged like pathological specimens in a museum each labeled as a distinct morbid entity, with a proper diagnosis, and all dependent upon actual disease. We must remember that environment, education, association and climate bear an important relation to vicious conduct; and it is only by weighing these various factors in each individual case that a scientific diagnosis can be made.

The conception of crime on the part of many reminds one of those days of superstition and ignorance when those affected with insanity, epilepsy, chorea and similar diseases were considered to be bewitched by the devil, and therefore were cast into prison, hanged and even burned at the stake. The history of witchcraft in our country is a blot upon old New England. To-day all is changed. We have asylums for the insane, colonies for the epileptics and homes for the feeble-minded, while the aim is to reclaim these unfortunates and to return them as useful members of society.

From our experience in the past in dealing with those mentally impaired, and from our present knowledge of the normal and diseased workings of the brain, can we not apply similar methods to the study and care of criminals and degenerates?

This problem is of vast importance to society and the state; and it behooves the medical profession to give the same study and thought to it as they would give to mental diseases in general. It is necessary that we keep in touch with this problem in order that we may give an intelligent opinion and wisely direct legislation along lines that are practical, scientific and just.—The Physician and Surgeon, August, 1896.

* Read by title before the Michigan State Medical Society, at Mount Clemens.

The sufficiency of the British government tests on the safety of petroleum as supplied to the public for burning in lamps has long been contested by experts and suspected by users. Mr. J. A. Wanklyn writes: "Petroleum is dangerous when it contains more than the minutest traces of the very volatile hydrocarbons, and it is safe when such hydrocarbons are absent or inappreciable. If our government does its duty, it will insist upon a flashing point of 105° at the very lowest; and, indeed, even a higher figure than 105° would be desirable. And certain other guarantees might also be enforced. With reference to the statements that serious practical difficulties stand in the way of forbidding petroleum of low flashing point, I am able to assure you that there are no difficulties which cannot be easily surmounted." A great deal of light oil is now being used for engines, for blowpipes, and for other purposes in the workshop, and there is liability that some of these light hydrocarbons may get mixed with the presumably safe burning oil.

RECEPTION OF THE EMPEROR AND EMPRESS OF RUSSIA BY THE FRENCH ACADEMY, OCTOBER 7, 1896.

THE salons now open contain few pictures that reproduce episodes of the Franco-Russian fetes of last October, and, further, the compositions in which we do find reminders of the visit of the young imperial couple have neglected the magnificent and stirring spectacles for scenes of quietness and simplicity. Among such pictures, the most tranquil is undoubtedly that representing the reception of their royal highnesses Nicholas II and Alexandra Feodorowna by the French Academy.

Its setting, the small Salle des Quarante, with its dark green paper dating from 1840, and its sober and severe ornamentation, gives it an air of gravity and contemplativeness. The portrait of Richelieu and the marble busts attentive upon their brackets to the academic discussions give it solemnity without any detriment whatever to the serenity of the place.

There is no parade in this picture, any more than there was in the real scene. At the desire expressed by the Emperor, the coats with green palms, the swords with mother-of-pearl hilt, and the feathered bicorn remained in the wardrobe of the Immortals. The academicians have their habitual attitude in the frock coat of the working sessions, and the word "Aulner" that the perpetual secretary is about to submit for discussion, in order that this day too may furnish its contribution to the advancement of the dictionary, is no great thing to symbolize here.

THE EMPEROR AND EMPRESS OF RUSSIA AT THE FRENCH ACADEMY.
PAINTING BY M. BROUILLET.

It was thus that Nicholas II desired it, and the Academy carried out his wish with scrupulous care.

The entire palace offered an oasis of absolute calm, an invitation having been addressed to its ordinary inhabitants to stay at home from the arrival until the departure of the august visitors, that is to say, from half past four until half past five.

One lived here for an hour isolated from the flourishes of trumpets, the cheers, the cavalcades and the clamor of the exterior. The only sign of gala that appeared at the Mazarin Palace was a marchioness standing at the door of the secretary's office.

Peter the Great, at the time of his unexpected visit in 1717, was received still more simply. In the hall of sessions he found but two academicians. On October 7 last his successor met with twenty-nine Immortals, and this was not the full Academy. Cardinal Perraud and MM. Emile Ollivier, Challemel Lacour and Paul Bourget, absent or sick; and Anatole France, Gaston Paris and Costa de Beauregard, not yet officially received, did not figure in the company.

The session had none the less an air of solemnity that was amiable and imposing in its simplicity. MM. Rambaud and Hanotaux received the President of the republic and our august guests at the door of the secretary's office, at the angle of the second court of the Palace of the Institute. The Empress ascended the stairs on the arm of M. Felix Faure, and it was at the entrance of the first Salle des Pas-Perdus that the President of the republic presented M. Legouvé, president of the office, M. de Vogüé, chancellor, and M. G. Boissier, perpetual secretary, to the sovereigns. In the Salle des Quarante, toward which M. Legouvé led the illustrious visitors, stood MM. Bertrand, De Bornier, Meilhac, Sorel, Lavisse, Halévy, Coppée, Sardou, Houssaye, D'Audiffret-Pasquier, Loti, Mézières, Cherbuliez, De Freycinet, D'Haussonville, Hervé, Thureau-Dangin, Pailleron, Sully-Prudhomme, Claretie, De Broglie, Brunetière, De Hérédia, Duc d'Aumale, Gréard and Lemaitre. While the Emperor and Empress and President Faure were seating themselves in the three arm chairs placed opposite the desk, the members of their suite occupied the circumference and the entrance of the hall of sessions of the Academy. This hall was invaded by a staff that would have been unable to find space in the first. M. Legouvé then opened the meeting and saluted the Russian sovereigns in these words:

"Sire, Madam:

"It is nearly two hundred years ago that Peter the Great, in the course of his voyage to Paris, arrived unexpectedly one day at the place where the members of the Academy were assembled, seated himself familiarly among them and mingled in their work.

"This visit, so full of cordiality, has remained in our archives as one of our most pleasant remembrances.

"Your Majesty is doing still more to-day; it is adding an honor to an honor in not coming alone. (Turning toward the Empress): Your presence, madam, is to introduce into our grave session something unaccustomed—a charm.

"How can we thank your majesties for deigning to take a seat in this little hall? The best way, it seems to me, is to give you an idea of what takes place herein, to allow you to witness one of our ordinary sessions, and to show you the academicians at work. The Emperor of Brazil once took part in our philological discussions; Grand Duke Constantine seemed to take pleasure in them; and this permits us to hope that your majesties will not greatly regret the few moments that they will have been kind enough to devote to us, and of which we feel the full value.

"Will it be permitted me to say so? This expression of sympathy is addressed not only to the Academy, but to our national language itself, which for you is not a foreign tongue. Such kindness well emboldens us. It carries us back to your immortal ancestor. To us, his visit is connected with yours, and in our gratitude we dare to address a prayer to your majesties: On this day, let us celebrate in advance the bicentennial of the cordial friendship of Russia and France."

After this address, M. François Coppée read a poem written for the occasion.

During the reading of this the sovereigns did not take their eyes off the poet.

The perpetual secretary afterward called his colleagues to work. In a short and clear address, he presented a few general considerations upon the dictionary of the Academy, recalling its seven successive editions, with their raisons d'etre, and, after this elucidation, brought the word "Aulner" into discussion. A rapid exchange of views was all the work accomplished.

At a quarter past five, M. Legouvé closed the session. The roll of those present was carried to the sovereigns with the request that they should affix their signatures, according to custom. Then the president proceeded to present his colleagues, the majority of whom respectfully kissed the Empress' hand. The imperial couple accepted a volume containing M. Legouvé's address, M. Coppée's poem and a paper entitled Peter the Great at Paris in 1717, the author of which, M. d'Haussonville, was not able, for want of time, to read it during the session.

The august visitors left the Academy with the same ceremonial as at their arrival, leaving behind them a kindly remembrance. That which they carried away with them, we dare say, was not one of the least agreeable of their stay in Paris; and the picture in which M. Brouillet has so exactly portrayed this session will doubtless cause as much pleasure at St. Petersburg as it has with us.

M. Brouillet has selected the moment at which M. Legouvé is delivering his address to their majesties. The figures of the painting and their scrupulously observed attitudes make a series of perfect portraits of this work. All the details are of irreproachable accuracy, and the whole gives an idea of calmness and repose.—Le Magasin Pittoresque.

STOCKHOLM.

CUT in on all sides by the sea, Stockholm is built on numberless islands, like Venice, but, unlike that ancient city, it is closed in by rocky heights in the immediate neighborhood. At the same time it is one of the most beautifully situated, most artistically built and historically most interesting towns of the earth.

On one side of the Ritterholms church is the bronze statue of the founder of the city, Birger Jarl, not a king, but a king's sire. This part of the town is the most ancient. Its site was particularly suitable, as an enemy approaching by sea from the Baltic could easily be stopped by putting a chain across the harbor. The town was often taken in the middle ages, and was won back again. A cloister which once stood on the site of the Ritterholms church was then the place of refuge for the beleaguered queen and her suite. On the other side of the Ritterholms church, in front of the former House of Lords, is a bronze statue of King Gustavus the First, holding the scepter in his right hand. The church itself, with its mausoleums, holds the royal burying vaults. There sleep Marshal Bernadotte, Charles the Fourteenth, with his descendants, the kings of the house of Holstein-Gottorff, the Carlovingians, and those of the house of Pfalz-Zweibrücken, Charles the Tenth, Eleventh and Twelfth, and finally their greatest king, Gustavus Adolphus, in the midst of his soldiers; the numerous flags on the tombs of the Baner and Torstenson are proofs of former renown in war. The dainty Gothic church is at the same time the Westminster Abbey of the Swedes. The names and coats of arms of the Knights of the Seraphine order are painted on the walls. Among these knights there is also a woman, the Czarina Catherine the Second. A quaint sight, especially if we remember what were her thoughts concerning the Swedes of her time and concerning their king, Gustavus the Third.

The statue of this monarch, who had such a tragic death, is on the east side of the royal palace, where you emerge in front of it, ascending from the sea.

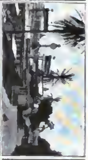
In the night of the 16th of March, 1792, the fatal shot fell from Anckarström's weapon in the royal opera house. This gigantic building stands on the Gustavus Adolphus Square, facing the North Bridge, the Holy Ghost Island, and the northwest front of the royal palace. The latter is one of the finest buildings of the world and one of the largest castle residences. It is built nearly square, and on the slightly longer side it measures 120 meters. The style is Italian Renaissance. The builder was Nicodemus Tessin, a Frenchman of a family that gave to Sweden both artists and statesmen. The northeast front holds between two projecting wings a beautiful garden terrace. In the south the steeple of St. Nicholas church stands aloft. This church had formerly the highest steeple of all Scandinavian churches. But after crumbling down several times, and being built up again, it was finally reduced to more modest dimensions. The government buildings of Stockholm, too, as particularly the museums dedicated to the Princess Sophia, are wonderfully built. Behind the palace is the fine German church, and by it the market place which saw the fight of the Swedish citizens against their nobles.

Of surpassing beauty are the surroundings of the city, particularly the zoological garden, with the careless, gay life of its summer nights. Here stands the bust of the Scandinavian poet, Charles Michael Bellmann, who celebrated these unrestrained frolics. He was the descendant of a German immigrant. In the south there is the Mosebakken Park. To the densely populated workingmen's suburb, Sodermalm, you are raised by the great Catherine elevator. By the bridge in front of this is an equestrian statue of the first king of the Bernadotte family.

Picturesque popular dress gives life to the streets of the capital, and if the snowshoed Laplander


Skeppsholm.


University at Upsala.


Open terrace.


Upsala cathedral.


The royal palace.


View of Stockholm from the Catherine elevator.


General view of Stockholm.


Riddarholms church.


Peasant woman.


Laplanders on skis.


Laplanders and hut.


Dalecarlian girl.


Catherine elevator.

VIEWS OF STOCKHOLM AND SURROUNDINGS.

must be sought further north, the peasant girl with the high white headgear, and the many colored apron over a red skirt, is much more frequently met. Specially fine is the dress of the valley girls, with their dark brown conical cap and the apron of ten colored stripes; they are the daughters of those valley men with which Gustavus Vasa drove the armored knights and archers of Christian the Second from the land.

The first royal Vasa rests in Upsala. The superb cathedral is the finest ecclesiastical building of the North, and at the same time one of the oldest. A shepherd's staff which is kept there behind the altar was given to the local archbishop by Pope Alexander the Third, before whom Barbarossa kneeled in 1177. There also sleeps the third royal Vasa, John the Third, with his Polish wife, the beautiful Catherine Jagellonica, and the founder of the race, Gustavus the First, with his three spouses, Catherine of Saxe-Lauenburg, Margerita Seijonhufond, and Catherine Stenbock. The second of these is the ancestress of Gustavus Adolphus.

Close by the cathedral is the university building. Before it stands the statue of the poet and historian, Eric Geijer. The studies at Upsala are rather prolonged. The university is very rich, and owns, among other possessions, the whole of Gustavus Adolphus' family estates. The students are divided according to nations, each nation having a splendid club building. The choirs of these nations give excellent recitals, and Terpsichore, too, is greatly honored. High above the town rises the remaining wing of the old castle, where Gustavus Vasa held his parliament, and where his insane eldest son, the peasant King Eric the Fourteenth, had the last Stures murdered. Some considerable distance further north lies the ancient village of Upsala, with its royal tombs in mounds, the only monument in remembrance of the vanished temples of the Norse Odin worship.

These are some of the historical shadows that flit over this ancient city. He who visits the Swedish capital, with its Scandinavian exhibition in summer, will enjoy beautiful days under the cool summer sky of this most interesting town. Beauty of nature, historical memories, and the amiability of the people together effect an ensemble unequaled in its kind.

Our illustrations are taken from the German periodical Ueber Land und Meer.

ALASKA DEVELOPMENTS.

The year 1896, however depressing elsewhere, was pregnant with richness for Alaska, says the Iron Age. The output of gold ran up to $5,000,000, or double that of the previous year, and the promise for 1897 is $12,000,000. Last year 11,000 persons, of whom 90 per cent. were miners, moved into the province, 8,000 going to the upper Yukon and 1,000 to Cook's Inlet. Fifteen thousand are expected this season on the Yukon alone, and all the agents, shippers and consignees are preparing for the rush. Bureaus of information are already open at Seattle, Juneau and other Pacific coast stations. New steamers are being fitted up for the trade and liberal schedules prepared. A large smelter is to be built at once at Seattle to treat sulphurets and refractory ores. Many miners, who have been wintering at Juneau, Sitka and Wrangell, are preparing for departure to the mines, and the advance on the Yukon has already begun.

The journey over the divide and down to the chain of lakes is not the hardship now that it was once. Late last fall the last men out discovered a short and easy route across the interior plains which can be traversed with pack mules in 30 days or less, and next spring, as soon as the rush begins, goods will be hoisted over the summit of Dyea Pass by block and tackle, and the cost of transportation from the steamer landing at Chilcoot to the head of barge navigation will be only 5 cents a pound, instead of $4, as two years ago. Later on a cog railway, like those which surmount Pike's Peak and Lookout Mountain, will be constructed, and then the difficulties of the 1000 mile journey from the coast to the diggings will be minimized.

Ten thousand prospectors in a given area, however extended, can accomplish much. Consequently, remarkable development resulted last year, not only on the upper Yukon placers and old quartz ledges along shore, but all over the golden provinces at points widely scattered and many hundred miles apart; at Norton Sound, at Unga, in the Aleutian peninsula, up on the British boundary at the headwaters of streams, and all along the Yukon River down to its very mouth.

Most of the propositions were low grade, but in not a few richness was found in nuggets whose maximum weight was 5 ounces.

Practically all of the gold produced last season in the Yukon region came from half a dozen little creeks and gulches tributary to Birch Creek and to Forty Mile and Sixty Mile Creeks. Between the last two points a winter camp of 800 souls called Klondyke has sprung up, so that the three populations of Circle City and the other two aggregate about 3,000 souls. At Circle City all the trades and professions are represented, while comfortable two-story frame buildings are rapidly supplanting the original log cabins. Among the most noted of these creeks are Mastodon, Deadwood, Bushnell, Discovery, Mammoth, Greenhorn, Mission, Goldbottom, Eagle, Bonanza, Preacher, Minuke and Independence. Minuke Creek is a new location of rare promise some 300 miles below Circle City on the Yukon. The Birch Creek district is 100 miles up stream above Circle City, which is the principal winter headquarters for miners. There is a portage of 12 miles first, and then a push up creek with bateau. This district is in disputed territory, and some 200 or more valuable claims are involved. Hence it would seem to be imperative that the boundary line between Alaska and British Columbia be confirmed without delay according to the joint survey of the two countries, as urged by Special Commissioner Hamilton, secretary of the North American Trading and Transportation Company, who is now in Washington for the purpose of persuading Congress to act. The Birch Creek discoveries were phenomenal, yielding in some cases $20 to $30 the pan, and $50 to $100 a day per man. With such lavish returns, miners could afford $10 per day for expenses, board and washing included. The total output for the season credited to this district was $2,500,000. Miners would not look at anything which offered less than an ounce a day. In this stretch of country there are a dozen rivers, each of which is as large as the Ohio, with tributaries innumerable called creeks. Preacher Creek itself is 700 miles long. No wonder prospecting was hard in the beginning and the outlook discouraging, with such magnificent cross country distances ahead before getting down to the task of removing the superincumbent detritus and débris from the gravel beds of the streams. But there is not a foot of their banks now found which does not contain auriferous soil; not the creek bed and adjacent bars alone, but ground 75 yards off from the water-courses is found to be rich in gold. Under the glacial drift old channels are often found which were never suspected from the surface indications. Of course massive quartz ledges must exist from which all this float gold emanates, and when these are finally located, as they soon must be, with the 15,000 miners who are expected on the ground the coming summer, the pounding of hundreds of stamps will disturb the quiet of the ancient Mastodon range. One such ledge, known as Quartz Mountain, three miles above 40 mile post, yields $11 per ton. There are several large trading posts besides business houses in this vicinity, each of which is the outfitting and distributing point for a mining district of its own, and they all have supply steamers running regularly down the Yukon. There are more steamers on the upper Yukon to-day than there are on the upper Mississippi.

Gold was first discovered in this region in 1880, but it is only for the past three years that the mines have been operated in force. The short working season and the terribly hard winters have alone kept off a rush to which that of California in 1849 would hardly be a circumstance. Henceforth, mining in Alaska is to be made comparatively easy.

Of the older quartz mines along the southeastern coast from Sitka to Juneau, and to nethermost parts, several of which, like the Treadwell, Mexican, Silver Bow, and Bald Eagle, are celebrated, they simply increase in richness as they develop. Six hundred stamps or more keep busy crushing out ore, which last year yielded $2,500,000 of gold bullion. Included are those operated by the Boston & Alaska, Nowell, Berner's Bay, Alaskan, Alaska-Commercial, Funter Bay, Juneau, Junlin, Apollo and Ebner companies, comprising in some instances a host of claims. Then there are the Unga, Admiralty and Green Island plants, and the large group of mines in the vicinity of Sitka, many of them of ancient date. With improved appliances for working, few fail to give satisfactory returns, and nowhere on the earth can better machinery and apparatus be found, such as gravity railroads, steam and electric tramways, several miles long, compressed air drills, snow sheds, hydraulic engines, etc. By the chlorination process the cost of mining and milling ore has been reduced as low as $1.08 per ton, with coal at $8. This is at Douglas Island. The coal bins of this concern hold 3,000 tons. In these days, mining operations can be continued all winter, since shafts have been sunk to depths where cold does not interfere with work. Some shafts are now down 1,000 feet. On the strength of present showing many important transfers of properties have been effected since fall. Four claims in the Sum Dum district, directly opposite the Bald Eagle, on Holkham Bay, have been sold to a French syndicate for $150,000. The Horrike and Mexican mines on Berner's Bay were sold to Portland, Ore., capitalists for $60,000. A Chicago syndicate paid $200,000 for the Funter Bay and Mountain King group of 11 claims, which are connected with the beach by a narrow gage railroad 2 miles long. The noted Willoughby mines went for $175,000, it is said. The Bonnie Brian went to St. Louis parties for $75,000. All the ledges in the vicinity of Douglas Island carry a good deal of free gold, and new discoveries and new claims are being located all the time. At Unga, in the Aleutian archipelago, some rich leads have been struck, and 20 new buildings have gone up. Considerable prospecting has been done with excellent promise on Kadiak, Afognak, and Whalcom Islands. On the latter, a free milling quartz ledge has been struck, which assays from $20 to $295 per ton. Ketchikan, between Nowell and Berner's Bay, is a new discovery which has been purchased by San Francisco parties, who will put up a stamp mill in the spring. The Apollo Company's output is said to average $40,000 per month.

Next in importance to the Yukon diggings are the Cook's Inlet placers, from which $175,000 was taken out last summer, chiefly from Turnagain Arm at the head of the bay, where the mining towns of Hope City and Sunrise are located. Other locations are at Chintna and Tyonic, further down, and at Anchor Point, near the mouth of the inlet. All the diggings are easily accessible by ocean steamers or vessels; the climate is mild; the vegetation luxuriant; fish, clams, and wild game abundant; and all the hydrographic conditions most favorable. The consequence was that the diggings became overcrowded last year with inexperienced persons indifferently equipped; and as it cost more to wash out the gold by hand than the gravel panned out, most all of the adventurers came home destitute or empty handed. But the gold is there, sifted all over the country in minute particles, 3 feet beneath the surface and averaging 50 cents to the square yard. Persistent prospecting has discovered this fact, and a big syndicate has been formed to get it out, called the Alaska Gold Syndicate Company, and their headquarters are in New York. The early spring proximate will be signalized by the employment of new mechanical processes which will render available and profitable large areas of goldbearing sand and gravel beds which heretofore it has not paid to work. Hydraulic machines, each capable of doing the work of 250 men, will wash out gravel at a minimum cost of 3 cents per cubic yard only; and as the placers yield from 50 cents to $3.50 per yard, the profits anticipated are large.

Manifestly, Alaska is looking up. Of all places in our land it feels the financial pinch the least. The town of Juneau has grown to large proportions on the strength of the boom. Seattle feels the electric energy in every part. Several lines of coastwise steamers connect Seattle and intermediate ports with Unalaska. Three lines of well appointed freight and passenger steamers ply regularly to trading posts, mission stations and populous towns on the upper Yukon. Regular communication is kept up between St. Michaels in Bering Sea and San Francisco, and there is regular monthly mail service overland to Circle City and the gold diggings. It was not so ten years ago.

SOLANDRA GRANDIFLORA—FLOWERS CREAMY WHITE.

SOLANDRA GRANDIFLORA.

This fine climbing plant, now rarely seen in gardens, is indigenous to Jamaica, where it goes under the name of the peach blossomed trumpet flower. Under cultivation the flower is white, with a purple tinge on the interior of the tube, but under the intense light of the tropics it is of a pale flesh color. It first flowered in this country at the Royal Gardens, Kew, in 1818, the figure given in the Botanical Magazine of that year having been taken from a flower furnished by Mr. Aiton. It also flowered in Mr. Salisbury's garden at Mill Hill, at about that time, and produced fruits there. The genus was named in honor of Dr. Solander, a pupil of

Linnæus', and fellow traveler of Sir Joseph Banks in his voyage to the South Seas. Cuttings of ripe wood strike readily in heat; and the cultivation of the plant is not difficult, provided a well drained fairly roomy border and plenty of head room are given it in the stove. We are indebted to Mr. G. Bolas, gardener at Hopton Hall, Derbyshire, for the flower from which our engraving is taken, and the following particulars: "The plant is of interest from the time the buds begin to expand. The change in the color of the flower is very remarkable, these turning from a pale olive green tinted with yellow to a creamy white on the fourth day. I received the plant in the summer of 1896, looking like a dried stick, with no signs of life in it, it having traveled, wrapped in a newspaper, from the island of Madeira. The plant had been stuck into the ground some days in a garden near Shrewsbury before I got it, and this gave me a hint as to the kind of treatment necessary to flower it."—Gardeners' Chronicle.

LATHYRUS SPLENDENS.

THIS handsome creeper has been in flower for some time past in the Cape House at Kew, England, where its brilliant scarlet flowers attract much attention. It has been likened to a sweet pea, but to our thinking is more like the perennial pea. It is a native of California, and is known as the "Pride of California." For the specimen whence our illustration was taken, we are indebted to the authorities at Kew.—The Gardeners' Chronicle.

LATHYRUS SPLENDENS—FLOWERS SCARLET (KEW).

THE ARCTIC SEA ICE AS A GEOLOGICAL AGENT.*

By RALPH S. TARR.

NATURE of Sea Ice.—Floating in the Arctic waters there are two kinds of ice—the sea-made and the glacier ice. The former develops in the autumn, first freezing over the protected fjords and bays and later covering the greater part of the Arctic Sea. As it freezes it incloses the glacier ice and consolidates the entire water surface into one mass of ice, which remains in this state until spring. The sea-made ice attains a depth of only a few feet, averaging perhaps fifteen or twenty feet. The wind, waves and currents move it about somewhat even in the winter, and by breaking it and piling the fragments on one another make the surface very irregular, greatly increasing the depth of some of the cakes. Moved by the tides and winds, it grinds against the shore and the shallow bottom, thus doing much work of erosion. In the spring, under the warmth of the rising sun, it commences to melt and goes floating away to the southward, where it finally returns to the liquid condition. Then, hundreds of miles to the southward, the individual cakes and scattered floes may introduce the conditions of the ice-bound sea of the North into the southern latitudes even late in the summer.

Nature of Glacier Ice.—Near the glaciers which end in the sea the surface of the fjords is littered with ice that has been derived from the glacier front. The melting in the warmth of the sun, the movement over an irregular bottom or the buoyancy of the water, make cracks in the glacier; and the action of the waves and sea water at its base undermines the ice cliff, so that there is a constant cracking and falling of bits and blocks of glacier ice. The air is constantly filled with the reports of varying intensity which accompany the breaking off of ice. Now and then a large piece, perhaps a great section of the glacier front, falls away and enters the sea as an iceberg.

This glacial ice, of whatever origin, incumbers the water of the fjords so that navigation even in a small boat is usually difficult. Slowly the ice drifts out to sea, for the summer winds prevail from the glacier-covered land, and hence there is a balance maintained. Were it not for these offshore winds, the glacier would soon fill the fjord with ice, and not being able to discharge its cargo, would be obliged to push farther out to sea. The sea ice is made in winter; the glacier ice is mainly supplied in summer. During the spring and early summer the movement of the sea-made ice is active, and then, when it has disappeared, its place is taken by the supply from the glacier.

Influence of Sea-made Ice on Erosion.—The sea-made ice of winter, covering the bays from shore to shore, protects the coast from the action of waves, and hence for the greater part of the year prohibits this form of erosion. Even when the ice is broken up and floating away, it protects in nearly the same manner; for the ice cakes and floes prevent waves from forming, and destroy those that have already been formed elsewhere. Even when the wind was blowing, while our ship was in the open sea off the Labrador coast, there was only an almost imperceptible swell, the remnants of the nearly destroyed waves of the ice-free, open water. However, when the ice cakes are more scattered, the waves use them as effective tools, hurling them against the coast and grinding them up and down upon it. Moreover, in the last stages a rim of ice clings firmly to the rock at high-tide mark, and no doubt the waves use this in places as a means of prying off fragments of rock.

It would be difficult to balance the protective and destructive action of this sea ice, but I believe, on the whole, that the average is in favor of protection. Nevertheless, the ice is used as a very effective tool, not merely by the action of the waves, which hurl the individual blocks against the shore, but chiefly by the grinding action of the tide. As the water rises and falls the ice is constantly ground against the shore, and that, as a result of this, it is doing much work is oftentimes clearly illustrated. Nowhere was this better seen during my visit to the Arctic than on the southern side of Baffin Land in White Strait. There the tide rises about thirty feet, and the mud flats, when exposed to view at low tide, were seen to be pitted and gouged in a manner quite closely resembling the surface of the mud flats on the Massachusetts coast after the clam diggers have left them. Carried in by the tide, the ice cakes strike against the muddy bottom and dig a hole, thus stirring up considerable mud, which is driven about by the tidal currents. Stranded cakes were everywhere present, and that they were engaged in the transportation of rock material was often shown by the presence of good sized bowlders, deeply embedded in the mud, where they had been dropped by the melting of the ice.

In this same region the grinding and transporting action of the ice was shown by the bowlder beaches. At the head of narrow and perfectly protected bays, there were beaches of bowlders, averaging a foot or two in diameter, and beneath these, forming the bottom of the bay, was mud. No other agent than ice could possibly have placed these bowlders in this position, and upon the stranded blocks of ice there were some bowlders journeying toward the beach. Similar bowlder beaches were found in the valleys of the land, showing that when the land was formerly lower this same ice action was in progress.

There is another way also in which the sea ice aids in the work of erosion on the shores. The rocks of the New England coast are covered with a protective mat of seaweed, barnacles and other forms of life, while the Arctic shores are entirely free from this covering, except in the minute and most protected crevices. Because of the ice grinding on the shore, life is impossible in the intertidal zone, although at a short distance below this both animal and plant life are extraordinarily abundant. Lacking the protection of this organic mat, the rocks are open to the direct attack of the water, and its agents must, therefore, work with greater rapidity, in a given period of time, than they do upon a similar coast that is protected by organisms.

Erosion by Glacier Ice.—In a less noticeable way the action of the glacial ice is the same. It is used in the same manner as the sea-made ice, and adds to its efficiency both in protecting and destroying; but there are two additional ways in which the glacier ice does work of erosion after it leaves the glacier. In order to understand the first of these it is necessary to know how the icebergs are put forth into the sea. So far as I could observe, there are several ways in which the ice comes from the glacier front. As has been said, some pieces, usually of small size, drop because of surface melting and others fall because the sea undermines the ice cliffs. Besides these sources of glacier ice there is the effect of the water, which buoys up the front of the glacier until a breaking results, when bergs, usually of large size, proceed from the front of the glacier.

In some cases this process of iceberg formation happens very quietly, and the front merely cracks off and floats away; but much more commonly the breaking is accompanied by a very decided disturbance. The end of the glacier has attained an unstable position; melting or undercutting cracks off a fragment, and the accompanying jar causes others to follow. The air is filled with sounds, as if of musketry, and from the glacier front there is a constant shower of small pieces and large blocks. Whenever a great mass falls away, numbers of others equally large or larger follow very closely. These do not break and float quietly away, but actually fall forward into the water. Even though the crack started from the bottom, there is no other way for the bergs to fall than to go forward. They must then attain a stable position in accordance with their form, and this often causes them to roll over completely, and float away bottom side upward. So a newly born iceberg may move off from the ice front either upon its side, bottom or top.

Not only are icebergs of massive form sent off from the glacier front, but if they come from a place that has been sufficiently crevassed and melted into irregular outline, the jarring caused by the falling and overturning may in the end completely destroy the berg and leave in its place only a multitude of fragments. One may often see an immense mass fall off from the ice front, and as it turns and rocks, may observe it break, until finally the original berg is entirely destroyed. When the iceberg is more solid, although numerous fragments continue to drop from its surface as long as it moves, it rocks and rolls backward and forward, perhaps for a half hour, before finally becoming quiet, and every piece that breaks off from this mass adds to the cause of rocking.

From the mass of ice thus cast off from the glacier there is sent outward a water wave, high near the ice front, but reduced to a low, almost imperceptible swell at a distance of a few hundred yards. Following this are other ring waves caused by the rocking and continued breaking. Though low, these are very powerful, for, like the earthquake wave, they are deep seated disturbances, not superficial like the wind wave. When they reach the shore it is whitened by surf as long as the waves continue to arrive. Then, although the surface of the fjord rises and falls only very gently, the shore line resembles the storm-bound coast of the open ocean; and during a stay of several weeks in the fjord near the Cornell glacier, at the base of the Upper Nugsuak peninsula (lat. 72° 15'), these were the only good sized waves that we saw, near the head of the bay. The waves caused by the production of bergs furnishes an additional instance of erosional work which Arctic ice does. Similar though smaller waves are formed when an iceberg runs aground and begins to break because of the jar.

When a berg comes off from the glacier it falls into the sea and rises and falls as it rocks backward and forward. Possibly as it moves it strikes the bottom; and certainly, as a result of the disturbance which it produces in the water, it stirs up the materials forming the bottom. After leaving the glacier front, in the course of its life history, the berg, in all probability, becomes stranded once or perhaps several times. Each time it touches the bottom it strikes a direct and heavy blow, and then, breaking slightly as the jar passes through it, and perhaps even falling into fragments, it rocks backward and forward in its effort to regain a stable position, thus striking the bottom again and again, and undoubtedly stirring up much mud by means of the disturbance of the water. Even when not striking the bottom, a strong wave is sent down to the bottom, and by this also there must be a disturbance. That these movements of the iceberg are performing work of distinct importance is proved by the muddiness of the water near the stranded bergs. Also in the berg fjords there is always the evidence of floating seaweed which has been detached from the bottom by this means.

In the fjord which I studied in most detail an interesting adaptation of animal life to this phenomenon was observed. On the face of the nunatak between the two lobes of the Cornell glacier a colony of gulls had their breeding place. The moment the report of a falling berg of large size passed through the air these birds left the cliff, and the air was white with these graceful creatures, flying directly, and with much eager chattering, to the front of the glacier, where they settled on the surface of the water and obtained a feast of shrimps and mollusks which had been stirred up and raised to the surface on the detached seaweed. This grinding against the bottom, and the disturbance caused by the wave produced by the falling ice, not only does considerable work of erosion, but also destroys much life. Notwithstanding this constant destruction, and it is certainly very great, the fauna at the bottom of the fjord was found to be abundant and varied.

Transportation by Sea Ice.—The sea ice of all kinds is also doing a great work of transportation. During our

* From the American Journal of Science.

voyage along the Labrador coast we passed through an unusual amount of floe ice. Shortly after leaving the straits of Belle Isle we encountered it, and were then in the ice almost continuously until we left the American coast a little north of Cumberland Sound. For nearly one thousand miles we were in sight of floe ice, and we therefore had unusually favorable opportunities for observing the conditions of this agent. As would be expected, the great number of floes were pure and white; but there were many that were transporting sediment. Even when the ice was freest from foreign materials it was estimated that about one per cent. of the cakes carried debris of some kind. In some cases the ice was perfectly dirty and black with mud, so that at times we mistook cakes for seals and walruses. In other places, in smaller areas, fully fifty per cent. of the floe ice in sight was discolored by a greater or less amount of detritus. These dirtier areas were undoubtedly derived from near the coast.

Some of the material that was being transported by the floe ice was very fine in texture, and apparently had been drifted upon the ice by the action of wind; but much of it was too coarse for this origin, and pebbles were frequently seen upon the surface of the cakes. No doubt these coarser materials were this part raised from the shore by the ice as it came in contact with the coast or passed near it; but probably the material was more commonly furnished by rills and streams from the land. I am certain that in the distance of one thousand miles of ice-covered sea our ship was within sight of thousands of tons of sediment, which was of course being slowly distributed over the bottom of the sea as the ice drifted southward.

Transportation by Glacier Ice.—Not merely is the floe ice carrying much sediment, but notwithstanding the statements of others to the contrary, the glacier ice is also a very potent agent in this respect. Among the bergs seen in the south it was rare to find one that had sediment in sight; but no doubt these, which had been floating for months, or possibly years, had long since given up their rock burden to the sea. Along the Greenland coast, however, sediment-laden bergs were abundant, and this was particularly true in the fjords near the glaciers.

The sea face of the Cornell glacier, like that of most others on the Greenland coast, is made of clear ice, almost absolutely free from even the finest sediment, excepting near the land margin, and below the nunatak which furnishes a medial moraine. The same is true of the ice face wherever the glacier ends on the land; but near the glacier bottom, both on the land and in the fjord, the ice bears considerable debris. That this was true of the ice bottom in the fjord was proved by the evidence of dirt and bowlder covered fragments that were floating in the water of the fjord. Some of these were entirely black, and we mistook some low ice masses for islands because of their discoloration. Moreover, in one of the bergs which was actually seen to come from the ice front this fact was definitely proved; for when it came off it turned with its bottom side uppermost, and floated away as a dark, discolored fragment, derived from a glacier whose exposed front was remarkably white.

There are thousands of tons of bowlders, gravel and clay sent into the sea from the front of the Cornell glacier every year, and much of this passes beyond the fjord out into Baffin's Bay. The sediment supplied to Baffin's Bay is in no small part derived from the bergs that are discharged into it. Some of this may go for long distances, provided the berg is turned bottom side up, although even in this case the water furnished by the melting of the surface of the ice will after a while wash the sediment away. When the berg keeps right side up, as is commonly the case, the debris rapidly escapes into the sea; and before the iceberg has moved far on its journey only clear ice, which of course forms the greater part of the mass, remains to float away. This is no doubt the reason why the southern bergs, even when these have recently turned upside down, as is frequently the case, are found to be free of sediment. They may have started on their journey with tons of debris.

Effect on Climate.—This brief statement of the geological effects of the Arctic ice would not be nearly complete if its effect upon the temperature of air and water were not mentioned. It chills the ocean on the American side, where the movement of the currents is toward the south, and by this means lowers the mean annual temperature of Baffin Land, Labrador and even New England, as everyone knows. In 1896 this effect was very clearly shown. An unusual amount of floe ice in the month of July so chilled the water on the Labrador coast that the cod fisheries were nearly a failure, because the cod fish would not come into the cold water near the coast. It was also most strikingly shown in early September, when we left the Greenland coast in summer weather, proceeded toward the southwest, and as our first view of the Baffin Land coast saw a snow-covered land. An ice-covered country was warmer than a nearly ice-free land, which, however, was bathed in water that had been chilled by the ice of the Arctic.

Cornell University, Ithaca, N. Y.

The leather industry of Germany is one of the most important of German industries, and may be said to occupy the third to fourth place, if all its branches are taken into account, and it is one that is daily expanding in every direction. According to the census of July 14, 1895, the number of persons engaged in it was 599,717, of whom 433,586 were occupied in the boot and shoe trade, 74,809 in making saddlery, harness, etc., 47,480 in tanning, and 16,218 in the glove trade. The commerce in hides and skins is immense and is one of the leading branches of trade, as is also that of tanning materials. In 1895 the value of the former imported was £7,297,700, and that of the exportation amounted to £2,579,050. Besides this, £1,549,300 worth of tanning materials were brought into the country. The exports of worked-up hides, leather, and "Wachstuch" (wax cloth) were valued at £4,925,450, and those of leather, harness, and pocket articles at £1,914,350.

The first vessel to be lighted by acetylene gas is the yacht White Queen, recently launched by Messrs. J. Duthie, Sons & Company, of Aberdeen, for Mr. J. Gordon Stewart, of Essex. She is 102 ft. over all, 18 ft. beam, 18 ft. depth of hold, and 190 tons gross register.

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THREE PHASE MOTOR AT BELLEGARDE.

AT Bellegarde, twenty miles below Geneva, the power of the Rhone is utilized for driving many different plants, partly by means of ropes, but mainly by electrical transmission. The most interesting of the works driven electrically at Bellegarde is the cotton mill recently erected. This mill, which is 550 yards distant from the water power and generators, employs one three phase motor of 120 to 170 horse power for driving the openers, carding, combing and drawing frames and fliers, and supplies 300 incandescent lamps. One 120 to 170 horse power three phase motor drives the self-actors, and one 15 to 30 horse power motor of the same class is employed for driving the ventilating fans and the workshops.

These motors, which were constructed by Brown, Boveri & Company, Baden, are illustrated in the annexed engravings, which we take from Engineering. The larger motors weigh 5·8 tons each and the smaller motor weighs 1·2 tons. These motors are started by resistance starters, and under normal conditions attain their full speed in the space of one minute. The inducing part of the field of the motor which connects with the mains is outside, and stationary, while the armature or induced part is made rotary, thus avoiding sliding contacts. The winding of both parts is similar, the core being composed of alternating laminæ of sheet iron and insulating paper pressed together between two outer rings and pierced near the periphery by equidistant oval-shaped (or circular) holes in which the windings are placed. Portions of the inducing winding are so bent and arranged as to be always at the same distance from the axis of the motor, and in large motors (from 40 to 120 horse power) the straight portions are placed in stiff paper or ebonite insulating tubes fitting into the oval perforations.

The winding of the induced rotary part consists either of wire or of copper bars, and is also placed in peripheral holes. By this construction all the magnetic resistances in both parts are reduced to a minimum, while the peculiar winding of the inducing part insures perfect symmetry, great economy of space, and easy inspection and repair. The wires or bars of the rotary part extend beyond the core on each side, the ends being bent and soldered together to form a drum winding short circuited on itself. The windings of both parts are symmetrical, but independent of each other as regards polarity, the peripheral holes being equidistant and the surfaces of the alternating iron cores being smooth and uniform all around, and any number of poles can be formed in the inducing part without any polar projections. By virtue of this arrangement, the motor is enabled not only to run non-synchronously with the generator, but with a considerable torque without separate excitation, so that commutators and brushes are entirely dispensed with.

To start these motors it is necessary to produce a difference of phase to destroy the equilibrium of forces, which, although the current be switched on,

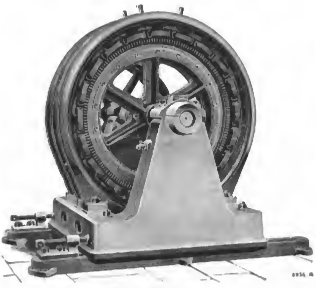


FIG. 2.—SIDE VIEW.

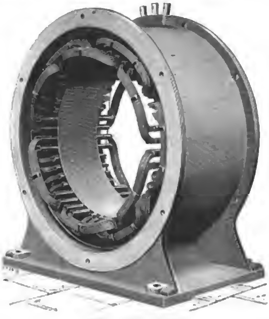


FIG. 3.—FIELD MAGNET.

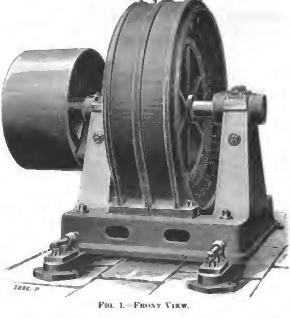


FIG. 1.—FRONT VIEW.

FIG. 4.—ARMATURE.

THREE PHASE MOTOR USED IN THE BELLEGARDE COTTON MILL ON THE RHONE.

causes the induced part to remain neutral, and prevents it from rotating unless it is set in motion. As differences of phase are produced by differences of self-induction, the desired object is brought about by adding to the ordinary winding of the motor a starting winding of small cross section having a different self-induction, so that when the two are placed in circuit with a generating alternator, a difference of phase and hence a rotary field is set up, which overcomes the neutral state and causes the armature to rotate.

The efficiency of these motors increases with the size and varies from 70 to 90 per cent. They are capable of developing 50 to 100 per cent. more than their normal power, and require no attendance beyond the renewal of oil once a week.

THE USE OF TURBINES WITH A HORIZONTAL SHAFT FOR RUNNING DYNAMOS.

IN recent years the applications of electricity have greatly extended, and this has very naturally led engineers to have recourse to the numerous waterfalls distributed over the face of the land for putting them to profit. In the first installations of this kind they confined themselves to the use of such motors as were then employed—waterwheels of all kinds, parallel turbines with vertical shaft, etc. These primitive apparatus, however, necessitated complicated arrangements, often cost considerable to keep them in repair, and were liable to give rise to serious accidents that sometimes occasioned a lengthy cessation of work. On another hand, it is well known that, contrary to what occurs with steam engines, the greater part of the expense connected with works run with water power resides in the cost of installation, the expense of maintenance and of running the machines being reduced to a minimum. It will be seen how advantageous it is from a technical as well as an economic view point to diminish the cost of installation as much as possible, while at the same time simplifying and improving the motors in such a way as to increase their performance.

It is to this end that have been directed the studies of hydraulic engineers, who have thus been led to the devising of special turbines designed more particularly for the running of dynamos. Among the numerous models of this kind we may mention the turbines with horizontal shaft which actuate dynamos directly without the intermedium of any transmission, and which were devised by the Brault, Teisset & Gillet establishment, founded by Mr. Fontaine, the inventor of the turbine that bears his name. These turbines are now very widely distributed, and we are going to describe a few types of them selected from among some of the more important installations.

The keying of the armature upon the same shaft, or upon a shaft forming a prolongation of that of the motor, is evidently one of the simplest and most rational of matters; but, unfortunately, such an arrangement is applicable only to falls of a height greater than 13 ft., since, below this figure, the velocity of the turbine is generally too feeble, especially when of a certain power.

On the contrary, with falls of from 25 to 40 ft. such an arrangement becomes very easy, and in this case the simplest application consists in employing (in placing it horizontally) the new American mixed centripetal turbine that we have already described in this journal. The turbine is installed in the same room with the dynamo, and then operates in an iron plate tank placed above the down stream level.

Figs. 1 and 2 show the installation of such a turbine. A frame of T iron, or, what is preferable, of cast iron, receives the tank, to one of the sides of which is fixed the discharge tube that enters the down stream water. The shaft of the turbine rests upon two self-lubricating bearings of considerable length, and, moreover, in order to prevent any loss of water in its exit from the tank, it passes through two stuffing boxes mounted upon the latter.

The opening and closing of the turbine is obtained very easily by means of a small handwheel carrying internally a fixed nut through which passes the threaded shaft that actuates the cut-off. This shaft likewise traverses a stuffing box at its exit from the tank. The jacket of the turbine in the interior of the tank is very strong, and a manhole gives access to the motor, so that it can be easily cleaned when necessity requires it.

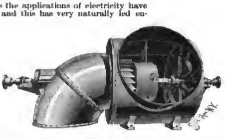


FIG. 1.—MIXED CENTRIPETAL TURBINE WITH HORIZONTAL SHAFT.

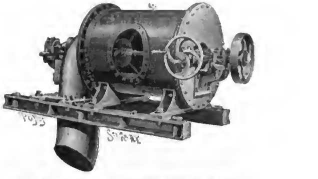


FIG. 2.—MIXED CENTRIPETAL TURBINE OF 45 H. P.

The following are the principal dimensions, etc., of the turbine represented in Fig. 2:

Motor	40 to 45 h. p.
Fall	42 ft.
Discharge	90 gallons
Velocity	630 revolutions
Diameter of delivery pipe	28 in.
Diameter of tank	3·5 ft.
Length of tank	4 "
Diameter of discharge pipe	20 in.
External diameter of distributer	20 "
Height of buckets	6 "
Diameter of turbine	13 "
Diameter of turbine shaft	2·4 "
Diameter of turbine shaft at bearings	2·4 "
Width of bearings	4 to 5·5 in.
Distance between bearings	8 ft.

The performance of these turbines varies between 80 and 87 per cent. of the total theoretical power. They are therefore excellent motors, which combine extreme simplicity with very great stability. Moreover, in most cases, in order to obtain a still better result, the dynamo and motor are mounted upon the same frame, which is cast in a single piece.

But, in the case of large falls and heavy discharges such turbines, since they are not balanced, may give rise to lateral thrusts upon the shaft. In order to remedy this inconvenience, the manufacturers have conceived the idea of keying two horizontal shaft turbines of opposite direction upon the same shaft. Fig. 3 represents a turbine established upon this principle.

This new type of turbine was devised a few years ago by the Brault, Teisset & Gillet establishment for application in a very special case. It was a question of running a sugar cane mill that had to be actuated by a reversible hydraulic motor that, when necessity required it, could be run backward in order to clear the mill when the cylinders became gorged and choked up by an excess of bagasse.

As this arrangement furnished good results, the manufacturers naturally thought of applying it to the direct running of dynamos. Fig. 3 represents a turbine of this kind designed to run the Bourganeuf works for transmitting electric power. The motor is established upon a solid cast iron frame which carries both the tank that holds the two turbines and the dynamos that they actuate. The tank is closed laterally by the two distributers of the turbines, which carry a central tubulure that permits of connecting them with each other by means of a cast iron tube that serves likewise as a cross brace, and thus permits of avoiding flexions due to pressure.

The orifices of these two distributers extend only over half of their circumference, and their opening and closing are regulated by means of bronze clack valves rendered absolutely tight through an ingenious arrangement of small grooves formed upon the surfaces in contact. The clacks of the two opposite distributers are connected with each other by means of steel rods and powerful springs which permit of balancing the pressure of the water in great part, and, consequently, require but a very feeble stress for their maneuvering. Moreover, they are very easily controlled by means of a handwheel mounted upon a shaft that carries pinions which engage with the rack that actuates them. This shaft alone is provided with a stuffing box.

The two turbines are of cast iron and hooped with steel. They are keyed outside of the tank upon the driving shaft that traverses the tube which connects the two distributers. This arrangement permits of dispensing with the use of stuffing boxes. As for the steel driving shaft, that is prolonged upon the external face of each turbine, traverses each of the two discharge tubulures through a stuffing box and rests upon two wide pillow blocks, each provided with three lubricating rings. At one of its extremities this shaft carries one of the halves of a coupling box that serves to unite it with the shaft of the dynamo that is placed in a line with it. The pillow blocks are mounted upon strong uprights cast in a piece with the frame.

The turbines are parallel reacting ones, each motor, running two turbines, furnishes 225 h. p. with a discharge of 213 gallons, and a fall of 95 feet, and with a velocity of 400 revolutions a minute.

The following are the principal dimensions of these machines:

Diameter of the tank	3·5 ft.
Length	3·75 "
Mean diameter of distributer	25 in.
Number of effective orifices distributed in two equal sectors to the right and left of the vertical shaft	14
Height of orifices	0·75 in.
Width " "	4 "
Mean diameter of turbine	25 "
Number of orifices	20
Width of "	5 "
Height of buckets	6·5 "
Number of revolutions	400
Diameter of steel shaft	5·25 "
" at the pillow blocks	4 "
Width of the " "	7·25 "

These motors, which have been run for two years, have given excellent results, and their operation, which is very regular, has never caused any heating. So it seems that the use of them is indicated in cases when it is desired to utilize falls of large discharge, and to obtain relatively feeble velocities of from 400 to 600 revolutions a minute for directly actuating dynamos, since, under such falls, centripetal turbines would give too high velocities that would necessitate the use of intermediate transmissions.

There is still another case in which centripetal turbines cannot be employed, and that is when it is desired to obtain these same velocities of 400 or 600 revolutions

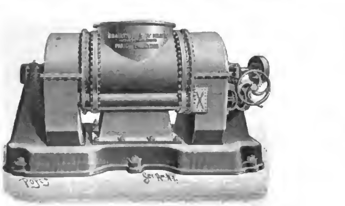


FIG. 3.—MIXED CENTRIPETAL BALANCED TURBINE.

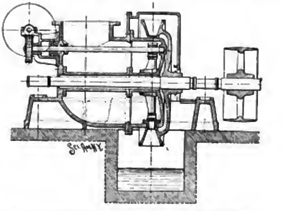


FIG. 4.—CENTRIFUGAL TURBINE WITH HORIZONTAL AXIS AND OF 100 H. P.

with a very feeble discharge and a very large fall. In this case it is possible to employ either Pelton wheels or a centrifugal turbine, a few of the types of which we are going to study.

Fig. 4 represents a turbine capable of furnishing from 30 to 60 h. p. with a fall of 325 ft. and a velocity of 700 revolutions a minute. This motor consists of a delivery pipe forming a frame and connected with the distributer. This latter carries a tubulure that is connected with the elbow of the pipe, thus crossbracing these two points and preventing any flexion of the distributer, which, at its lower part, is provided with a certain number of orifices, the size of which is calculated according to the discharge, and the opening and closing of which are regulated by means of a circular cut-off. This latter revolves around the central tubulure, and the maneuvering of it is effected by means of a handwheel, which, through the intermedium of an endless screw, actuates the shaft that carries the pinion which gears with the rack of the cut-off.

The turbine is keyed upon a steel shaft that rests upon two pillow blocks that are mounted upon a solid cast iron frame which surrounds the turbine. A cast iron tank prevents the water from overflowing in the room.

The principal dimensions of this turbine are as follows:

Mean diameter of distributer.....	27 in.
Width of orifices	1·6 "
Height	0·4 "
Number..........	5
Mean diameter of turbine.......	28 in.
Number of orifices	44
Number of revolutions.....	700
Discharge of turbine....	15 gallons.
Height of fall	328 ft.
Power of turbine	30 to 60 h. p.
Diameter of shaft	3·6 in.
" " " in bearings ...	2·8 "
Width " " " " ...	5·5 "

If the discharge of the fall is still less, the delivery pipe will naturally have a much smaller diameter. In this case it is possible to adopt the arrangement shown in Fig. 5, that is to say, to cause the shaft of the turbine to pass over the delivery pipe. The distributer is then reduced to a truncated sector forming a continuation of this pipe and carrying the orifices necessary for the admission of the water as well as space for the cut-off. This latter is thus asymmetrical with respect to the vertical plane passing through the shaft of the motor. As for the rest of the installation, that is like that of the one described above. Two turbines of this type have been applied to the running, through belts, of the dynamos used for the lighting of the city of Fort-de-France, Martinique.

The following are the essential characteristics of them:

Mean diameter of distributer....	36 in.
Width of orifices	1·2 "
Height.	1 "
Number	6
Mean diameter of turbine	3·6 in.
Width of orifices	2 "
Number "	36
" of revolutions	400
Discharge of the turbine	25 gallons.
Height of fall	160 ft.
Power of turbine	40 h. p.
Diameter of shaft	3·2 in.
" " " in bearings.....	2·2 to 2·4 in.
Width " " "	6 and 5 "

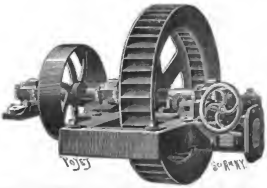
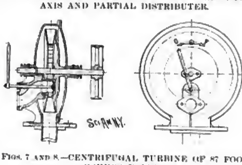


FIG. 6.—CENTRIFUGAL TURBINE WITH HORIZONTAL AXIS AND PARTIAL DISTRIBUTER.



FIGS. 7 AND 8.—CENTRIFUGAL TURBINE OF 87 FOOT POUNDS POWER.

Fig. 6 represents another turbine of the same type established for a still smaller discharge.

Finally, we shall give a description of a turbine of exceedingly small size, established on the same principle as the preceding, and designed to furnish but a little power when, for example, it is desired to use the pressure of city water mains for domestic purposes. These small motors, which may be employed for running dynamos, elevators, sewing machines, dumbwaiters, etc., are much used in foreign countries. The turbine is set in operation by means of a simple lever connected with the cut-off that acts upon the distributer. The

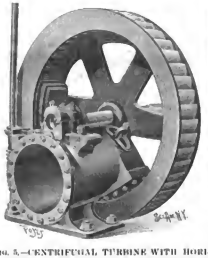


FIG. 5.—CENTRIFUGAL TURBINE WITH HORIZONTAL AXIS AND PARTIAL DISTRIBUTER (40 H. P.)

entire turbine is placed in the interior of a cast iron tank which is absolutely tight. The water is discharged at the bottom through a pipe that may be bolted under the base of the turbine.

The principal dimensions of the type represented in Figs. 7 and 8 are as follows:

Mean diameter of distributer .	8 in.
Number of orifices...	1
Width of orifice.......... ...	0·32 "
Diameter of turbine..........	8 "
Number of orifices......	26
Width..........	0·75 in.
Diameter of delivery pipe.....	1·6 "
Height of fall	160 ft.
Discharge of turbine..........	1 pint
Power	87 ft. pounds
Diameter of driving shaft....	0·75 in.
Number of revolutions.......1,375	

In this general study we have confined ourselves to an examination of motors designed for the utilization of high falls, but intend to complete the subject some time in the future by a description of turbines utilizing a low or medium fall of water.—Le Genie Civil.

Reports from the Wilcannia district of Australia state that the drought is being severely felt there. On some stations very heavy losses of stock have already occurred. On one holding alone the manager estimated that the sheep were dying at the rate of 1,000 a day. Within a radius of 100 miles of Wilcannia the country has the appearance of a desert. Right through to Wentworth, a distance of 200 miles down the river Darling, there is not a vestige of feed to be seen, while the seventy mile track toward Hay is in an equally deplorable state. Up the river toward Bourke there is no feed until Windbar is reached, a distance of 120 miles from Wilcannia. In the Menindie district also grave fears are expressed as to the result of the prolonged drought. At the end of last year there was only 867,800 sheep in the district, being a decrease from the previous year of 90,960. The loss since 1883, which has been at the rate of 100,000 per annum, is almost entirely due to bad seasons.

THE ACCOMPLISHED UTILIZATION OF NIAGARA.*

IN response to your request for succinct data as to the net result of the enterprise at Niagara, in regard to which the Electrical Engineer has made so full a record during the past six years, I am glad to be able to submit figures of a remarkably encouraging character. The project has never promised so well as now, either in practical operations or in those financial results which, as Mr. Brunel insisted, can alone justify even the greatest engineering plan.

Since work was begun in 1890, we have had at least four financial crises, and other influences, deterring the establishment of new industries requiring power. Considering these general and well-known adverse conditions, coincident almost with its life, the wonder is that this company has steadily progressed, and, as above indicated, has virtually reached the point of self-support. Under such conditions, and in view of the necessarily experimental character of the work, it would have been folly at any earlier date to seek to provide for an installation larger than necessary to demonstrate that this enterprise can accomplish real work and promise real profits.

The plans of the Cataract Construction Company and the works of the Niagara Falls Power Company are so far completed that delivery of power to customers in Buffalo has been successfully instituted, and the calls for power under contracts actually executed (and in excess of the present capacity of the works) will provide annual rentals which, with contracts in negotiation, represent a total income from that source falling not far below half a million dollars.

The present electrical installation comprises three dynamos, each of 5,000 electrical horse power, of which one should be kept as a reserve; but the demand has made such reservation impossible, and the contracts already made for 15,825 electrical horse power exceed not only the prudent, but the actual, capacity of these works, which require immediate extension, with every prospect of prompt and profitable employment.

The proposed extension involves doubling the present capacity of the transmission line to Buffalo which, already in successful operation, is delivering 1,000 electrical horse power; the extension of the wheel pit for its full length, so as to have capacity in all for ten 5,000 horse power turbines and dynamos; the installation of seven 5,000 horse power turbines and dynamos, in addition to the three now in operation; and the extension of the power house to cover the new installation. The work of such an extension of the wheel pit is about one-third completed; the right of way from Niagara Falls to Buffalo is complete; the pole line already erected has a pole and cross arm capacity for 20,000 electrical horse power, with copper conductors in place for 5,000 electrical horse power. Upon definite proposals already received, the entire installation above described can be accomplished within the year 1897.

As a concrete presentation of the facts, I will add a list of the contracts for power up to election day, 1896. No more eloquent statement as to results achieved could be given if I were to fill a volume of your journal:

HYDRAULIC POWER.

	Horse Power.
Niagara Falls Paper Company	7,200

ELECTRIC POWER.

Pittsburg Reduction Company (aluminum).......	3,050
The Carborundum Company (carborundum).....	1,000
Acetylene L., H. & P. Company (calcium carbide).	1,075
B. & N. F. Electric Light and Power Company (local lighting)	500
Walton Ferguson (chlorate of potash)......	500
Niagara Electro-Chemical Company (peroxide of sodium)............	400
B. & N. F. Electric Railway (local railway).......	250
N. F. & S. B. Railway Company (local railway)..	250
(All from October 1, 1896.)	
Buffalo Street Railway Company (22 miles transmission)...............	1,000
(From November 15, 1896.)	
Acetylene Light, Heat and Power Company.	
(From February 1, 1897)	1,000
(From March 1, 1897)	1,000
(From delivery, say, November 1, 1897).....	2,000
Mathieson Alkali Works (soda ash).	
(From June 1, 1897)............	2,000
Buffalo Street Railway Company..	1,000
Buffalo General Electric Company (lighting).. ..	3,000
(From November 15, 1897.)	
Totals	25,225

SUMMARY.

Total hydraulic power sold—Niagara......... ..	7,200
Total electric power sold—Niagara............ .	13,025
Total electric power sold—Buffalo	5,000
	25,225

ADDITIONAL.

Albright & Wilson, Limited (electro-chemicals). .	400
1896—Grand total.	25,625

It will be obvious, at a glance, that Niagara has already started on its career as a great chemical center, and thus justifies the predictions that the chemical trades would center ultimately around the sources of cheap power in large quantity.

* By W. B. Rankine, Secretary Niagara Power Company, in the Electrical Engineer.

EXPRESS COMPOUND LOCOMOTIVE WITH AUXILIARY GEAR.

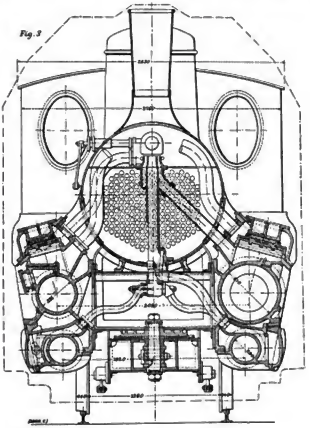
IN designing the compound locomotive with a single pair of driving wheels, which is shown in the accompanying engravings, the constructors, Messrs. Krauss & Company, of Munich and Linz, aimed at combining the chief advantages of uncoupled wheels with the greater traction force which four coupled engines afford in starting and in mounting gradients, while further they desired to secure a more perfect adaptability of the engine to the various requirements concerning speed and power that arise during ordinary working conditions. Very large cylinders, quite desirable in cases of great power being required at low speed, give unfavorable results at high speeds. If the customary two cylinders are to be adhered to, it is hence necessary to keep down their dimensions. The design adopted by Messrs. Krauss & Company enables them to adapt the dimensions of the cylinders to the conditions obtaining at high speed, while for low speeds they bring into use an auxiliary engine; thus they double their tractive power when needed and can exert a great pull with early cutoff.

It is owing to the willingness on the part of the directors of the Bavarian State Railway, and particularly of the chief of the engine department, Oberregierungsrath Mahla, to test an entirely new arrangement, that this idea has been carried into execution. Having ordered twelve engines of the standard four coupled express type, Class B XI (cylinders 17·52 in. and 26·38 in., 24 in. stroke, 73·2 in. driving wheels, and a steam pressure of 13 atmospheres), the directors conceded that one of these engines should be built on this new plan, provided the construction was such that the locomotive could, in case of failure, be converted so as to fairly resemble a standard engine.

The locomotive herewith illustrated, known as No. 1400, is the only one of its kind. It was delivered in December, 1895, was on regular duty during the months January to March, 1896, was then sent to the Bavarian Exhibition at Nuremberg, and since October, 1896, has been again in uninterrupted service.

Our illustrations clearly bring out the chief constructive peculiarities. Apart from the rear axle, which has its bearings in a short outside frame, the main framing is internal; the cylinders of both systems, as well as their gears and valve chests, lie outside. In accordance with the conditions of easy convertibility, the chief parts are like those of Class B XI. The boilers, e. g., are identical—not reckoning slight changes in the smokebox, necessitated by the alteration in the pipes—and so also are the complete bogie (of the type designed by Mr. James Stirling, Southeastern Railway), and the driving wheels, for which latter the designers would have preferred a larger diameter. Above the rear axle, the main framing is provided with sectors in order to admit of the eventual addition of horn plates for the reception of the axle boxes of a coupled axle, should the present construction not be ultimately approved of.

The main pair of cylinders drive the 73·2 in. wheels; the dimensions of the cylinders are smaller than those of the B class, the diameter of the right hand side high pressure cylinder being 15·16 in. and that of the left hand side low pressure cylinder 24·01 in. The stroke in both cases is 24 in. The cylinders are inclined 6 in 100,



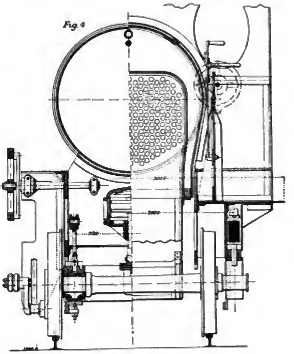
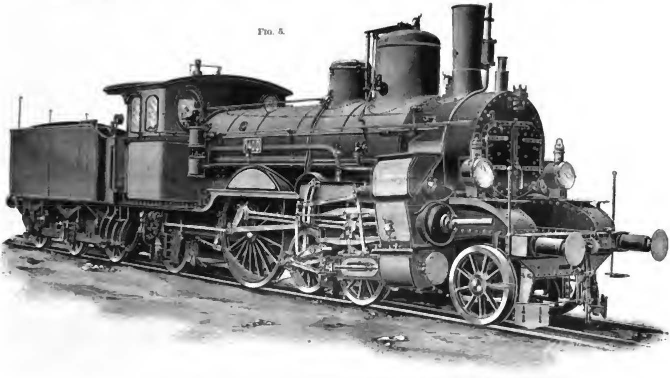


FIG. 5.



COMPOUND LOCOMOTIVE, WITH AUXILIARY CYLINDERS, FOR THE BAVARIAN STATE RAILWAYS.

because the auxiliary cylinders had to be placed underneath, not to interfere with the engine profile. The valve chests, which are fitted with American balance slide valves, also lie inclined, in both the longitudinal and transverse directions. The valve gear is of the Heusinger-Walschaert type. The cutoffs are the same on both sides, while the cylinder ratio is 1 : 2·51.

The receiver pipe passes through the smokebox, and bears above a safety valve loaded to 5·5 atmospheres, and in front a Ricour air suction valve. The exhaust into the chimney takes place through an annular pipe. The starting gear consists of a Lindner cock, which is connected with the reversing rod, and at full gear allows the steam to pass from the boiler to the receiver, and of a Krauss interruption slide, which, fixed outside the high pressure cylinder and worked from the right hand link, prevents the passing of steam at those positions of the crank when the pressure in the receiver would only impede the starting.

The auxiliary engine is intended to insure a reliable and powerful start. It is entirely independent of the main engine, and is fitted, as shown in the engravings, with two equal sized cylinders. It is not in use except when a heavy pull is needed, that is, in starting, and on steep gradients. Under ordinary conditions, the auxiliary engine is not switched in, so to say, and its wheels are kept off the rails and remain stationary. Having regard to the low speed at which the auxiliary driving wheels are to run, and to the circumstance that the weight and bulk of the auxiliary gear should be as small as possible, these auxiliary wheels have been made the same diameter as the trailing wheels, namely, 1 meter (39·3 in.)

The auxiliary driving axle has its bearings in horn plates which are formed by plates riveted to both sides of the main frame. This axle has not any ordinary bearing springs, but is connected with the springs of the main driving axle in such a way that these springs tend to lift the auxiliary axle from the rails and press its bearings against the upper stops. Normally, therefore, the auxiliary driving wheels remain 30 millimeters (1·2 in.) above the rails.

When the auxiliary engine is to perform its duty, the auxiliary driving axle is depressed by the action of the piston of a vertical steam cylinder of 412 millimeters (16·2 in.) diameter, fixed above its center, as shown in Fig. 7. The piston with its ball socket joint and bronze footstep bears against a cast steel support, fixed between two plates which connect the bearings. Steam is admitted through a threeway cock, which is seen on the right hand side of the dome in the perspective view, Fig. 5; at the same point is also a lubricator for the piston. The steam pipe to the cylinder passes under the lagging of the boiler, lest the pipe freeze. An automatic valve in the gear cylinder takes the condensed water down into the ashbox. The steam which is discharged on releasing the shaft was originally permitted to escape as it liked; later on a special pipe was added which conveys this steam into the chimney, in order to avoid soiling the engine by the oil in the steam.

The levers between the auxiliary axle bearings and the bearing springs of the main driving axle serve the further object of equilibrating the load when the auxiliary axle is lowered, in such a way that the load is distributed over the running wheels. When the auxiliary wheels are pressed down, the whole engine is raised about 1 in. on the springs; at the same time, however, the front links of these springs are depressed by about 2 in., so that the deflection of the springs, and consequently the load upon them, remain unchanged. The springs are hence slightly inclined under both conditions. When the auxiliary axle is lowered, their front extremity lies a little lower, when the axle is suspended, a little higher than the other extremity. The forces entering into play are as follows: When the auxiliary motor is out of use, the weight available for adhesion consists of the dead weight of the main driving wheels and their attachments, amounting to 3·73 tons, plus the load on the driving springs amounting to 11·12 tons, making a total of 14·85 tons. When the auxiliary axle is pressed down, however, the following additional adhesion weight becomes available:

	Tons.
Deadweight of auxiliary axle and its attachments	2·130
Pressure on piston of loading cylinder	17·330
	19·460
Less upward pressure exerted at the point, B, by the levers connected to the driving springs	4·635
Additional adhesion weight	14·825

It will thus be seen that the adhesion weight amounts to 29·67 tons when the auxiliary axle is being used, and to 14·85 tons in the other case.

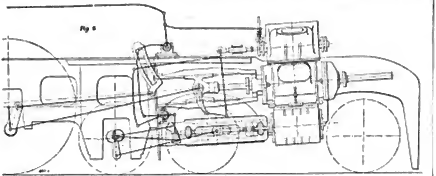
The cylinders of the auxiliary engine, which have a diameter of 290 millimeters (11·4 in.) and stroke of 460 millimeters (18·1 in.), are bolted to the lower side of the large cylinders; their valve chests lie horizontally and point outward. The arrangement is clearly shown by Figs. 3 and 6.

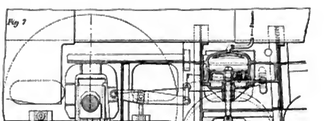
The working gear is shown by Figs. 5 and 6. From these views it will be seen that the crossheads and guides of the auxiliary motor are inclosed within a metallic case, lest dust and dirt from the hind bogie wheels should injure them. The valve gears of both engines are actuated from the same shaft, and are permanently connected in such a manner that during forward motion, which corresponds to equal performances by both engines, the large engine works with a later cutoff. For this purpose the length of the suspension link is such that when the expansion blocks of the large engine are at midgear, those of the small engine are somewhat below this point; a cutoff at 0·4 in the case of the former corresponds to a cutoff of 0·17 in that of the latter. The small engine is fitted with Stauffer grease cups, which are economical and sufficient for the short periods during which this auxiliary engine has to run. For the purpose of lubricating the piston and slide valve, condensation apparatus has been provided which feeds only as long as the engine is under steam.

The regulator slide of the auxiliary engine is put in the smokebox, in the steam pipe of the large engine. As a result the small engine receives steam only when both regulators are open. The rod actuating the auxiliary regulator passes laterally out of the smokebox, and is manipulated by a special handle from the driver's footplate. In order to render impossible any mistakes on the part of the driver, such as giving steam to the auxiliary axle before putting it under load, or releasing it again before shutting off steam, the regulator handle and the shaft which actuate the threeway cock have been made mutually interlocking.

As regards other special features of the locomotive, the mechanical sandbox should be mentioned. In the locomotive as originally constructed steam sanding apparatus was used. But the steam device froze during winter—the Bavarian lines are exposed to exceedingly cold weather—while the mechanical device since adopted has always answered during severe frost. The sand is fed from the box by a screw conveyor with left and right handed thread; the screw is actuated from the right hand link of the main engine in the way we shall explain presently. Above the small gear wheels the sand pipe branches and contains a clack valve, which is controlled by the pull on the threeway cock; thus the sand is strewn in front of either the auxiliary driving wheels, when they are lowered, or of the large driving wheels. As long as the block is at the center of the link, the apparatus will manifestly be at rest.

In most respects the engine under notice is of the usual construction. It is fitted with a Westinghouse brake (which acts upon the driving and the smaller hind wheels), with Petri's recording speed meter, actuated from the right hand eccentric of the main engine, with Körting's safety injectors, with Nathan lubricators for the main cylinders, and with the requisite apparatus for steam heating the train. The locomotive being somewhat longer than those of the standard type, but requiring less water, the limited length of the turntables has caused no difficulties. A small three axled tender carrying 13·7 cubic meters (481 cubic feet) of water has proved amply sufficient; the new standard engines have four axled tenders on two bogies and carry 18 cubic meters (636 cubic feet) of water. The chief dimensions are:





COMPOUND LOCOMOTIVE, WITH AUXILIARY CYLINDERS, FOR THE BAVARIAN STATE RAILWAYS.

Boiler:

Grate, length	2181 mm. (85·8 in.)
" width, front	1021 " (47 ")
" " aft	991 " (39 ")
Grate area	2·2 m.² (23·7 sq. ft.)
Mean diameter of boiler shell	1400 mm. (55·1 in.)
Thickness of shell plates of boiler barrel	15·5 " (0·61 ")
Height of center line of boiler above rails	2275 " (89·5 ")
Number of tubes	236
Diameter of tubes, outside	45·5 " (1·79 ")
" " inside	41·0 " (1·61 ")
Length between tube-plates	3780 " (148·8 in.)
Heating surface of fire-box, outside	9·9 m.² (106·6 sq. ft.)
Heating surface of tubes, outside	122·1 " (1314 ")
Total heating surface	132·0 " (1421 ")
Steam pressure	13 atm.

Main Engine:

Cylinder diameter, high pressure	385 mm. (15·16 in.)
Cylinder diameter, low pressure	610 " (24·01 ")
Cylinder ratio	1 : 2·51
Stroke	610 mm. (24·01 in.)
Driving wheels, diameter	1860 " (73·2 ")

$$\text{Pull}^* = 0{\cdot}52 \frac{38{\cdot}5^2 \times 610 \times 13}{1860} = 3290 \text{ kg. (7231 lb.)}$$

Auxiliary Engine:

Cylinders, diameter	290 mm. (11·41 in.)
Stroke	460 " (18·11 ")
Driving wheels, diameter	1000 " (39·33 ")

$$\text{Pull} = 0{\cdot}65 \frac{29^2 \times 460 \times 13}{1000} = 3290 \text{ kg. (7231 lb.)}$$

Gear cylinder, diameter	412 mm. (16·22 in.)

Lengths:

Wheel base of engine	7400 mm. (291·4 in.)
Total wheel base of engine and tender	13550 " (533 ")
Length over all, locomotive	10220 " (402 ")
Length over all, locomotive and tender	16570 " (652 ")

Weights:

	Single. Tons.	Duplex. Tons.
Bogie	24·15	14·75
Auxiliary driving axle	....	14·80
Main driving axle	14·80	14·80
Rear axle	12·85	7·45
Total weight	51·80	51·80

Tender:

Diameter of wheels	1000 mm. (39·33 in.)
Axle distance of wheels	3800 " (149·6 "

	Tons.
Weight, empty	15·0
" of water	13·7
" coal	5·0
" fittings	0·5
" fully equipped	34·2

The brake has twelve blocks and acts upon all the wheels.

The above figures show that the total pull of the locomotive is 2 × 3,290 kilogrammes = 14,462 lb. = 6½ tons, which is a high value. In order to facilitate a comparison with English engines, Messrs. Krauss & Company assume a steam pressure of 190 lb. and driving wheels 7 ft. in diameter: they would require cylinders of 26·5 in. diameter, which would not be acceptable for high speed locomotives.

We have already mentioned that the locomotive was first put to regular duty during the months January to March, 1896. This was on the lines Munich-Ulm, Treuchtlingen, Regensburg, Simbach, Salzburg, Kufstein, Kempten. Objections had previously been raised that the auxiliary engine could not be thrown in without a jerk, and that its steam pipes would, owing to their use for short periods after long intervals, be exposed to freezing. Both objections have proved unjustified. The throwing in of the auxiliary engine has taken place when the locomotive was running at speeds up to 75 kilometers, 46·6 miles. The operation was so smooth that persons standing on the engine and not watching the driver did not notice the change over. It has, moreover, been found that the switching in will rarely be required while the locomotive is in motion. It soon became apparent that the help of the small engine was needed over short distances only. It had been calculated that the auxiliary engine would have to help, not only in every start, but at every gra-

* Messrs. Krauss & Company base the pull of compound engines upon the high pressure cylinder, and reckon only 52 per cent. of simple expansion.

dient of 1 : 200 or more for a distance of about 2 kilometers, 1¼ miles. Under this supposition, the locomotive would, on its regular trip, have had to do about 15 per cent. of duplex working. As a matter of fact, it has resulted that the large engine takes trains of 180 tons alone over gradients of 1 : 100. There is only one long gradient of 1 : 100 and 1 : 94 between Freilassing and Traunstein, on the Salzburg line, where the assistance of the auxiliary engine is required over a distance of 12 miles. Trains of 200 tons are to ascend at a speed of 31 miles (50 kilometers) on this gradient. Otherwise the use of the auxiliary plant is limited to starting and getting up speed after slow runs, and on the whole the duplex working is confined to 5 per cent. of the total track length. During the official tests which took place in March last, the engine hauled a train of 183 tons over a long gradient of 1 : 300 and 1 : 400 with a speed of 54 miles per hour; on a gradient of 1 : 55, between Miesbach and Schliersee, a speed of 30 kilometers (18·6 miles) was realized. In that case, of course, with the assistance of the auxiliary engine. Snow and ice have as yet not caused any trouble, although severe snow storms, followed by extreme cold and heavy drifts, have been experienced.

The complicated construction and the large number of axles have been commented upon adversely. With regard to the former point, it may be said that the four-cylinder engines of Mallet & De Glehn, whose right of existence nobody questions now, are certainly not any simpler. A four-coupled engine of the latter type has, on the contrary, two more coupling rods and four more bearings, and the secondary mechanism is essentially more bulky than the auxiliary engine. It is further to be considered that De Glehn's secondary mechanism is always running, which means additional friction, oil and repair. With the auxiliary engine under notice, which is idle for 95 per cent. of the run, those additional expenses come in to the amount of 5 per cent. only. There is a further advantage as compared with compound locomotives fitted with change-over gear, in being able to work with fresh steam in both engines. Such locomotives have to resort to strong throttling, and hence to waste steam, while the main and the auxiliary engines of Messrs. Krauss & Company work with full boiler pressure.

As concerns the second point, the locomotive has exactly as many driving and carrying axles as the "American Atlantic" type, which is more and more coming to the front. Together with its three-axled tender, it has not any more axles than the normal "American" class, with its four-axled tender.

The external appearance will probably not please in England, since the locomotive is built on the German "everything outside" style. It must be granted that the two separate and entirely different gears make the engine look somewhat complicated, to which appearance one has first to accustom oneself. But this might be altered. It is manifest that four-coupled locomotives could be provided with this auxiliary gear. Such engines might rival the six-coupled locomotives of the American ten-wheel class. We are indebted for cuts and particulars to Engineering.

OXYGEN, FRESH AIR AND HEALTH.*

ALL biologists agree that oxygen is the prevailing essence of the body; is the most important agency and is the chief element in the health of man.

The world is seven-tenths oxygen. The great oceans are three-fourths and the water we drink is two-thirds oxygen.

The solid matter of the earth is over sixty per cent. oxygen by weight and ninety per cent. in bulk. If a man weighs 150 pounds, 110 is oxygen, and if the oxygen were set free, it would fill 750 cubic feet of space.

What we call fire is but the dangerous activity of oxygen. The flame you see is but the union of carbon with oxygen. Oxygen is all activity; its mission is to change; it tears down only to rebuild; if it destroys by fire, it saves all the materials and quickly uses them to rebuild something else. It is the great builder of the animal kingdom and is man's greatest friend, for it destroys the bad parts of the living tissues and builds good in its place.

Oxygen may become dead if confined in a close room; that is why we notice that dead smell in rooms that have been closed for any length of time.

Sunlight also has much to do in keeping air in a healthy condition. No plant can grow in the dark, neither can man remain healthy in the dark, ill ventilated room. When the first blind asylum was erected in this State (Mass.), the committee decided to save expense by not having any windows. They reasoned, very logically, as the patients could not see, there was no need of any light. It was built without windows, but ventilation was well provided for, and the poor sightless patients were settled in the house. But things did not go well; one after another began to sicken and great languor fell upon them; they felt distressed and restless, craving for something they hardly knew what. After two had died and all were ill, the committee decided to open the windows. The sun poured in and the white faces recovered their color; their flagging energies and depressed spirits revived, and health was restored. Is this not a good illustration of the necessity of sunlight in the animal economy?

Take an illustration of the necessity of oxygen in water, which I have told you is of itself two-thirds oxygen in composition. Let it stand in a room any length of time, it becomes insipid; the oxygen entrapped between its particles has become dead or lost. Take fishes and put them in a limited quantity of water and they soon die. Why? All healthy water has oxygen entrapped between its particles. The gills of the fish are its lungs, and they take water into their mouths and force it back through their gills and thus take out the oxygen, the same as is done in our lungs; and as soon as this is all consumed, they die, just as we would do if we breathed carbonic acid gas.

Small bodies of water become slimy and covered with what some call "frog pond," but frogs have nothing to do with it, for if you confine rain water in hot weather, the same thing will occur. There is no water so pure as that you see in the little rivulet dashing over the rocks, as in that way a full supply of oxygen is entrapped between its particles. It is the same with large bodies of water thrown about by the wind. Air is only two-fifths oxygen, but without it there could be no fire. The greater the draught, the greater the fire. You all know that fire burns much better some days than others, from the fact that the barometer is higher, causing a greater pressure on a square foot of air, and is as 1,000 to 824 for moist easterly air, and that which we inhale contains thirty-six times more moisture than pure westerly breezes. If the air was pure oxygen, we should quickly burn up, and when a fire was once started it would finish up the building before the engine could reach it. Fire is the union of oxygen and carbon. You know the electric light has to have carbon.

A drop of blood contains the entire human body in miniature, in that it holds all the elements for a complete being. The blood carries carbon for the purpose of exciting the oxygen, and the air cells of the lungs bring it oxygen, just as the bellows will blow air upon the fire. The greater supply of air, the greater the draught and the more intensely the fire will burn. So life exists just in proportion as we breathe and exercise. In a good sized man there are three million of cells, one half air and the other half blood cells.

I have said that oxygen and carbon have a strong affinity for each other. At birth, at the first inspiration, the oxygen enters the air cells; a process called endosmosis takes place, whereby the oxygen passes into the blood cells, uniting with the carbon, forming carbonic acid gas, which in turn passes into the air cells (just as the rays of the sun pass through glass) and is breathed out.

Before the oxygen entered the blood cells the blood was full of carbon and dead matter. Carbonic acid gas is the union of oxygen and carbon. If the blood did not get any oxygen, it would not move out of the cells, but when uniting with oxygen it becomes red, vitalized, life giving blood and immediately starts on its mission through the arteries to every part of the system, there to undergo a change in the capillaries (which are hair like, hollow tubes), which convey the blood from the arteries to the veins. Here in the capillaries a burning process takes place, just as in the stove. Here the oxygen exchanges its life-giving properties for carbon. It builds and destroys.

Now if there is more carbon than oxygen, that is, if we do not breathe enough air, dead matter remains in the system because there is not enough oxygen to burn up all the carbon. Then there is dead matter left in the system which may cause disease of some organ. This burning is life. If you lift your arm or your little finger, it is necessary that some oxygen should burn up some carbon in order to set free the force necessary to move the muscle.

Fire and heat are simple expressions of force. The engine moves by force of the consuming oxygen and carbon. You burn when you exercise. The more exercise, the faster you burn, and more dead matter is thrown off, for this burning is life, and there is no other way of existing. Does this not show us that all animals should have some exercise in order to keep them in a healthy condition? We cannot live without burning, and we cannot burn without oxygen, which we only get in the air we breathe, and without it we could not exist three minutes. Were we obliged to rebreathe our own breath we should die in that length of time, as the air we exhale is full of poison. Life depends upon oxygen and must have it. Refuse it or stay in a room where the air is not changed, the blood stagnates, dead matter remains in the system, the muscles put on a tired feeling due solely to this cause, and is cured, not by medicine, but by natural oxygen alone. I say "natural," as chemists can produce oxygen, but it lacks Nature's vitality. When we do not have oxygen enough the heart acts feebly, the impulse of digestion is withdrawn, and the food may ferment in the stomach or pass out undigested and unused; the blood clogs the brain, the head begins to ache, the dead tissues through the body, instead of being carried off by the exhalations of the lungs and skin, are collected in every nook and corner, where they become a fertile soil in which the bacilli of tuberculosis thrive (as they enjoy just such soil), and are sure to make their nest; and colds, catarrh, and all other diseases of the air passages find good stamping ground.

All scientists say that oxygen carbonizes the tissues, and whenever carbon and oxygen meet, a fire ensues, as real as in the stove or furnace. This is what keeps the blood up to a much higher temperature than the hottest summer day. One great trouble with humankind is that we do not half breathe. A man weighing 150 pounds should have a lung capacity of twelve pints, while many persons only inhale from two to three pints at each inspiration; but singers inhale from seven to eight pints.

In a drop of blood there are one million corpuscles, and at each inhalation twenty millions are destroyed and their places are taken by new ones. The oxygen tears down all the worn out tissues. This dead matter is caught up by the blood and whirled back to the lungs, where it again meets oxygen, is purified and goes bounding back through the system.

One great cause of colds, catarrh, bronchitis and pneumonia is that the system has become weakened by being in hot, ill-ventilated rooms, not being supplied with enough oxygen to take care of all dead matter, and in this weakened state persons go out into cold air—a change of 60 or 70 degrees—and take cold, not from getting into the cold air, but by coming from overheated, sealed up rooms. If we were more in the habit of warming our blood in winter by taking brisk exercise "under the canopy," and less inclined to coddle ourselves up in nearly hermetically sealed rooms warmed with hot air furnaces with a tropical temperature, we should be a far healthier people. The presence of dead matter in the system is the cause of most diseases, and as oxygen is the greater factor in preventing them, I have thus emphasized its effect on the system.

I have said blood dies every second; that it loses its character of being blood; therefore, we conclude nutrition of the body consists of the white disks and the vitality in the red disks.

If, after eating pure food, fresh outdoor air is breathed, the blood will show a large increase in red corpuscles, but by drinking tea, coffee or other stimulants the red disks are decreased in serious proportions. Loss of sleep would do the same. Now before a cold is caught the white corpuscles must be diminished by weakness, preventing the blood from assimilating food. This being the case, we should let all stimulants alone, eat such food as will be readily assimilated to restore the white corpuscles and take a full supply of fresh air to transpose them into red disks. Colds should be looked after, as they often start their victims toward the grave, but no half breathing will do this. Nine-tenths of the human race do not half breathe, consequently the blood is not in a healthy condition; but full, deep inspirations many times a day, with perfect exhalations, will make the blood healthy and send a cold kiting.

Oxygen is indispensable in the food we swallow to insure perfect digestion. The teeth were made for a mill to grind the food, and during this process both oxygen and saliva are mixed with it. Persons who have lost their teeth or bolt their food are more liable to become dyspeptic from the lack of oxygen and saliva, as these are the most active promoters of digestion.

We often see pale, anemic young ladies; they need not be so if they would eat proper food and fill their lungs with fresh air, which is free to all. They live mostly on bread, sweetmeats and candy, food ill fitted to make white disks; consequently what little oxygen they get cannot make red disks, as there is not proper material by which nature can perform her duty. The system is full of dead soil, the person becomes debilitated and is a fit subject for tuberculosis germs to make lodgment in, for that is just the soil they like and in which one will produce over sixteen million in twenty-four hours, as they double every hour. Figure it up and see if I have the figures large enough.

There are two gallons of blood passing through the lungs every twenty-four hours, requiring more than three thousand gallons of pure air to change it from death to life giving blood. The colorless young ladies spoken of do not more than a quarter breathe; probably most of them do not inhale more than two or three pints of air at each inspiration, when it should be from six to eight to change the blood and rid the system of the dead matter which is clogging it.

If a person inhales enough fresh air and has disks enough to keep up a good fire, the bacilli tuberculosis will burn up, as they cannot stand such a fire. Fresh air is a germicide. To illustrate how quickly the air in a room may become impure, I will cite a school room examined in Boston. Two hours after the children had been in session there was found eighteen times more carbonic acid gas than there should be to keep them healthy. Many of you remember the black hole in Calcutta, where 146 prisoners were put into a close prison and only 23 were found alive in the morning, and most of those died of typhus fever in a short time. After the battle of Austerlitz 300 prisoners were placed in a prison and 260 died in a very short time. This shows us very clearly the effects of bad air on the animal economy.

A few words about consumption.

Bacilli germs make a lodgment in the lungs, and, like a besieging army around a city, every weak point is attacked, and the weaker the lung, the greater the predisposition to consumption. At night the rooms are shut tight to exclude all fresh air possible; they have on double windows and cotton stuffed in every crevice where it is thought there is a chance for fresh air to enter; then occupants feel weak in the morning and wonder how it is they take cold so easily. They think there must be something wrong about their system and consult the doctor. I have noticed that children who have bronchitis or pneumonia (especially among the poorer classes) are usually worse in the morning, when we should expect to find them better. Why? During the day, especially where there are children, the door is opened every few moments and in comes a gust of fresh air, but in the evening, as soon as they are in bed, the door is shut for the night, and this may be closed so that there is no chance for fresh air to enter the room of the sick child. Between the stove, mother and child all the oxygen is soon consumed. The child's lungs are so diseased that they can take in but little air, consequently need that of the purest kind, but this they cannot get in these close rooms, and many a parent has been made to mourn the loss of a dear child simply because she thought if it got a breath of fresh air it would take cold. It is the same with consumptives. When the cool weather comes they shut themselves up in hot, ill-ventilated rooms or go south, where the air is rarefied by heat, instead of taking exercise several times a day in open air and filling their lungs to their utmost capacity. They never inhale more than a third of what they should to burn up the bacilli that have made a lodgment in that part of the lungs which have been deprived of fresh air. They shut themselves in close, ill ventilated rooms in the fall, and do not permit themselves to get a breath of fresh air until spring. One bacillus in such a lung will produce more than sixteen million in twenty-four hours. They often spit upon a handkerchief, and each sputa contains three million germs and in twenty-four hours over six billions. If any of this sputa dries, the germs float and we inhale them, we breathe them in, and if they find the right soil, you can see how fast they propagate. You hear a great deal about consumption being contagious. The germs are floating everywhere, even in this room, but don't be alarmed. Physicians, nurses, members of the family in attendance, washerwomen and ragpickers never take it if they get a fair amount of fresh air. If you could only see the air of this room under a microscope, you would want to get out. As fresh air is a germicide, no one ever need take consumption, as fresh air costs nothing. I always expel all the air from my lungs when I leave a crowded room, and fill them with fresh air as soon as I get outside.

Be sure to have your sleeping room windows open more or less, as the weather may be, and you will be less subject to take on any disease, which is usually brought on by overeating, eating at improper times or improper food and staying in ill-ventilated rooms.

* By L. W. Curtis, M.D., in Health Culture.

The results obtained by the Nobel Dynamite Corporation in 1896, while not quite as good as expected, have been sufficient to warrant the payment of a dividend of 12 per cent. for the year, says the Engineering and Mining Journal. The capital is $9,127,000, in $50 shares. The net profits in 1896 amounted to $1,101,599, and the sum paid as dividend was $1,089,450. The report says that the business was good during the year, except in Germany. It is proposed now to establish factories in the United States.

ENGINEERING NOTES.

In April last there were recorded 105 train accidents in the United States, of which 36 were collisions, 63 derailments, and 6 other accidents. Nine accidents were due to road defects, 32 to defects in equipment, 15 to negligence, 4 to unforeseen obstruction, while 43 are "unexplained."

The production of coal in France in the second half of last year amounted to 14,736,819 tons, as compared with 14,311,596 tons in the corresponding period of 1895, showing an increase of 415,233 tons. Of the coal raised in France in the second half of last year, 8,791,888 tons, or about 60 per cent., were produced in the basin of the Nord.

There has been forged at Darlington, and is to be sent to Belfast, a stern frame weighing 41 tons; while after brackets are still heavier—55 tons gross. These castings are records in weight, for the Oceanic, now building in Belfast. It is, however, a curious feature in the story of the building of this modern leviathan that most of the material will be rolled, cast, and forged in England for this Irish built steamship.

In the course of the experiments on materials which the United States government have instituted, stone was not overlooked. According to the American Architect, it has been found that the temperature and moisture have a very great influence in determining the resistance of stone. In order to measure the permanent expansion which is known to take place in stones after soaking in water, a large number of samples were soaked in water at 32 Fah., then in water at the boiling point, and again in cold water, and afterward dried. On measurement, all the stones so treated were found to be larger than before, the actual linear expansion being from one-fifth to one-tenth of one per cent. On testing for resistance to various strains, however, the strength was found to be greatly affected by the water treatment.

The London Times says: "The congress of the German and Austro-Hungarian Association for the Promotion of Inland Navigation has just been held in Vienna. A protest was raised against the agrarian opposition to the development of inland navigation. It was pointed out that the agricultural classes greatly underestimated the value of such facilities for disposing of their products. Among other projects reported on were the Danube and Oder, and the Danube, Moldau and Elbe canals, and the proposed connection of the river Isar at Munich with the Danube. The question of utilizing the water power in the Moldau-Danube canal to generate electricity was also considered. The Biwa-Kioto canal, in Japan, was referred to as providing power not only for traction on the canal itself, but for lighting towns along its banks and for driving the machinery in a number of factories."

There was recently launched from the Elswick shipyard of Sir W. Armstrong, Whitworth & Company (Limited), Newcastle, the first-class cruiser O'Higgins, which is being built to the order of the Chilean government. The principal dimensions of the O'Higgins are as follows: Length, 412 ft.; breadth, 62 ft. 9 in.; draught (mean), 22 ft.; displacement, in tons, 8,500. Her armament will consist of four 8 in. Elswick quick firing guns; ten 6 in. Elswick quick firing guns; four 4.7 in. Elswick quick firing guns; ten 12 pounder Elswick quick firing guns; ten 6 pounder Elswick quick firing guns; four machine guns; three torpedo tubes. She has an armor belt extending over the greater portion of her length, 7 ft. wide, and 7 in. to 5 in. at the ends. The two barbettes, containing 8 in. guns, are of steel 6 in. in thickness. The casemates are 6 in. thick, and the conning tower 9 in. thick. The protective deck is 2 in. to 1½ in. in thickness. The total coal capacity is 1,200 tons, and the guaranteed speed is 21¾ knots. The O'Higgins is sheathed with wood and coppered.

The Purdue University has closed a contract with the Schenectady Locomotive Works for a new locomotive to be used in its engineering laboratory, in connection with courses in railroad engineering, says The Engineer. The new locomotive will possess a number of features which are quite new. It will carry a steam pressure of 250 lb. and will have cylinders so arranged that it may be used as a simple or a compound engine. The cylinders and saddle will be made up of different castings, and the centers will be so chosen as to allow the use of cylinders up to 30 in. in diameter. Several cylinders will be provided, and these, with a suitable series of bushings, will allow for different cylinder ratios in compound work. The whole machine will thus afford facilities for dealing with conditions quite beyond the limits of present practice. From its place in the laboratory, the old locomotive, hereafter to be known as "Schenectady No. 1," and which in the course of its six years' sojourn in the laboratory has been run an amount equivalent to 20,000 miles, and has served in an experimental study of many important problems connected with locomotive design, will pass into active service on the road, while the new engine, "Schenectady No. 2," will take its place upon the testing plant.

Since the introduction of torpedo boat destroyers considerable inconvenience has been experienced in consequence of the excessive vibration which is set up when these vessels are steaming at high speed. Various experiments have been carried out by the dockyard officials and naval engineers with a view to discover some means to overcome the difficulty, and in some cases the vibration has been somewhat reduced. Messrs. Laird Brothers, of Birkenhead, who have already completed six destroyers of various types and have four more in course of completion, have apparently solved the problem by a series of successful experiments in the Quail, a thirty knot destroyer, recently delivered at Devonport. This vessel underwent a trial with two balanced weights, weighing collectively 540 lb., fitted to her high pressure crank webs, while two more weights, weighing collectively 645 lb., were attached to her low pressure crank webs. The engines were run at various revolutions up to their full speed, and the corresponding vibration of the vessel was noted. It was found that the vibration, both horizontal and vertical, at a speed of 280 revolutions, was only one-half that which had been recorded before the balance weights had been fitted, while the engines ran steadily throughout.

MISCELLANEOUS NOTES.

The United States Department of Labor estimates the value of goods produced in the various penitentiaries of the States and Territories in 1895 at about $20,000,000.

The existence of a clear, crystal-like mineral, which, when looked through, produces two images of a single object, is one of the curiosities of science. It is stranger still that the only known supply of this double refracting spar is found in Iceland, and is controlled by the Danish government. The mine is located on the east coast of Iceland, about four miles from the trading station of Eskifjord, on the mountainous slope 350 ft. above the sea level. This mineral is used largely in optical instruments, polarization apparatus, and the like, and as the supply of the mined mineral has been exhausted, the mine having been closed for some years, the Danish government has recently leased the mine to its former owner. A pound of this mineral is worth about twenty seven dollars.

America is still maintaining its new reputation as an exporter of manufactures, says Industries and Iron. The returns for March of this year, recently issued, show that the valued total exceeded by no less than $2,000,000 the heaviest preceding totals for the same month, and exceeded by 30 per cent. the total for March, 1896, and by 60 per cent. the total for March, 1895. The whole of the figures relating to this relatively new traffic are too long to be enumerated here; but, taking them as a whole, their general aspect seems to show that the United States is in possession of what may very likely prove to be a staple, even if not a greatly increasing, trade in her manufactured products abroad. It is true that the promises of extensive exports of steel rails and billets have hardly been carried into effect, but in cycles and machine tools there is clearly a rapidly expanding commerce, with England particularly.

According to L'Echo des Mines, Paris, bullets of paper covered with aluminum are the latest thing in ammunition. "This invention, made by a French officer, tends to do away with the seriousness of wounds made by lead balls, or those with steel coverings, owing to the rupture of the bony parts. According to the patent granted to Richard Lüders, of Görlitz, the precision of fire is in nowise affected, but the passage made by the projectiles through the body is absolutely straight and permits of a rapid closing of the wound. As the number of the wounded will be as large as formerly, and as in most cases their incapacity will be as complete, we ought to look upon this discovery as calculated to satisfy the sentiments of humanity. But, nevertheless, the innovation has small chance of success, for we must recollect that, in war, unfortunately, the end sought is to put the largest number of men possible into a condition where they will be unable to bear arms for the longest time."

In the June Century there is an article by Prof. W. O. Atwater giving the results of experiments at Wesleyan University, during which men remained for several days in a small, copper lined room. The object of the experiments was to determine "How Food is Used in the Body," and Prof. Atwater says: The inference is that the people in professional and business life in the United States, where labor is mostly mental and indoors, are inclined to eat more than they need, and that the special excess is in the fuel ingredients, that is to say, the fats and carbohydrates. Taking the results of these and various other experiments together, the details of which cannot be quoted here, we are, I think, justified in believing that the diet of a very large number of people is out of balance. It contains an excess of food material, and this excess is largely due to the eating of fat meats, sugar, and the starchy foods. These results of accurate observation and experiment thus accord with and explain the current opinion of hygienists as to our ordinary habit of overeating.

On steamships one often hears the expression "slip of the wheel," says the Mining and Scientific Press. Now the meaning of this may be explained in a very simple manner. It is the difference between the actual distance run and the distance that would have been covered had the propeller acted upon a solid substance instead of a fluid. In other words, the expression may be understood as the lost motion of the propeller. It is usual to allow a certain number of revolutions to the propeller or paddles to the mile, and at the end of a stated time the estimated distance run by the ship, according to the number of turns made, is compared with the actual distance run by the ship according to observation of the heavenly bodies or by the patent log, and the difference between these two records is expressed as a percentum and entered in the log book as "slip of wheel." Retardation by reason of head winds and high seas comes under the head of slip. For example: If the distance run according to revolutions is 100 miles, and the actual distance run is 75 miles, the slip of wheel is 25 per cent.

It is an idiosyncrasy with Prof. Hughes, inventor of the microphone, that his remarkable inventions have all been worked out with the most simple and commonplace tools. Thus, in devising the microphone, the apparatus was of the most primitive character, and, with the exception of a Bell telephone receiver, could not be appraised at more than a few pence. This apparatus had a child's halfpenny wooden money box for a resonator, on which was fixed by means of sealing wax a short glass tube filled with a mixture of tin and zinc, the ends being stopped by two pieces of charcoal to which were attached wires, having a battery of three small Daniell cells—consisting of three small jam pots—in circuit. The wires were led away to a Bell telephone placed in an adjoining apartment. The money box, which had one end knocked out, served as a mouthpiece or transmitter, while a Bell telephone was used as a receiver. Sounds scarcely audible, and some absolutely inaudible, to the unassisted ear, were by means of this apparatus delivered with startling loudness through the Bell telephone. Numerous experiments of the utmost importance to physicists were carried out by Prof. Hughes with this apparatus, and with modifications of it, all proving that he had succeeded in producing the simplest and most powerful electric articulating telephone ever known.—Invention.

SELECTED FORMULÆ.

Aureol, a New and Harmless Hair Dye.—A writer in the Deutsche Med. Zeitung contributes the following formula for making a perfectly harmless hair dye which, from the golden tint produced, is called aureol. The dye consists of two liquids, used in equal parts. The first is a 3 per cent. solution of hydrogen peroxide. The second consists of—

Metol	10	parts.
Amidophenol hydrochlorate	3	"
Monamidophenylamin	6	"
Sodium sulphite	5	"
Alcohol	500	"

Dissolve the sodium sulphite in the alcohol, and add the rest of the chemicals. In use equal parts of the two liquids are taken, and only so much as is necessary at the time should be mixed. The hair is first freed from grease, etc., by washing with plenty of soap and thoroughly rinsing, and, after drying, the dye is applied with a comb with fine teeth.—National Druggist.

Test for Lubricating Oils.—The American Electrician gives the following simple tests for lubricating oils: A good test for oil is to place single drops of different oils in line upon a piece of plate glass about 2 feet to 2 feet 6 inches long, one end being raised about 6 inches to 8 inches to form an inclined plane. This test should be conducted in a room where there is little or no dust. The drops of oil start from the top of the inclined plane upon a race with each other. The first day sperm oil will be found in the rear, but after a time it will overtake the others, and be found in motion even after some others have dried up. An oil having a light body runs quickly and dries quickly, but an oil that has both a body and a free flow will readily be detected by this test. An oil may have a good body and yet tend to gum badly, which quality will also be easily detected upon the glass. A good test for the presence of acids is to put small quantities of oil in copper dishes, which are easily made by depressing bits of sheet copper with a round faced hammer. If acid is present, it will attack the copper and produce verdigris. As a result of experiments carefully made and extending over a year, it was found that iron was least affected by seal oil, and most by tallow oil when it is not deacidized. Brass is not affected by rape oil, least by seal oil, and most by olive oil. Mineral lubricating oil has no action on zinc and copper, acts least on brass and most on lead. Lard oil acts least on tin and most on copper. Sperm oil acts least on brass and most on zinc. From the tables given it is found that mineral lubricating oil has, on the whole, the least action on the metals experimented with, and sperm oil the most. For the journals of heavy machinery, either rape or sperm oil, in admixture with mineral oil, is the best to use, as they have the least effect on brass and iron, which two metals generally constitute the bearing surfaces of all engines.

Heat Indicating Paint.—"At a recent meeting of the London Physical Society," says Industries and Iron (Lit. Digest), "Dr. Thompson exhibited specimens of a heat indicating paint composed of a double iodide of copper and mercury, originally discovered twenty years ago by a German physicist. At ordinary temperatures the paint is red, but when heated to 95° C. (200° F.) it turns black. Paper painted with this composition and warmed at a stove exhibits the change in a few seconds. A yellow double iodide of silver and mercury is even more sensitive to heat, changing from yellow to dark red at a temperature of 45° C. (113° F.) Many suggestions have been made from time to time as to the utility of such a paint; for instance, it has been suggested that it might be used on machine bearings to give warning of their heating, but we opine that the costliness of the material would in a great degree prevent its adoption either for this or any other of the numerous purposes to which it might otherwise be well applied."

Ant Exterminator.—(1) Powdered borax sprinkled around the infested places will drive them away, as also will powdered cloves. Grease a plate with lard, they will leave sugar to go to it, and then turn them into the fire; cracked nuts will answer the same purpose. Oil of turpentine run into the cracks with a sewing machine oil can.

(2) A good preventive for the inroads of ants is a stripe of carbolated petrolatum about half an inch in width drawn about the places frequented.

(3) Cape aloes .... 1 pound.
Water .... 1 gallon.
Boil together and add to the mixture:
Camphor, in small pieces .... 6 ounces.

(4) Sprinkle their haunts with quicklime containing a twentieth of its weight of powdered camphor.—Pharmaceutical Era.

Photographic Hints and Formulas.—

From Liesegang's Photographischer Almanach.—(Amer. Photo. Jl.)

Varnish.—Ground glass substitute (Lauler):

Ether	100	c. cm.
Sandarac	10	grm.
Dammar	3	"
Dissolve and filter, then add		
Benzole	50–60	c. cm.

The more benzole, the coarser the grain.

Varnish (Valenta).—

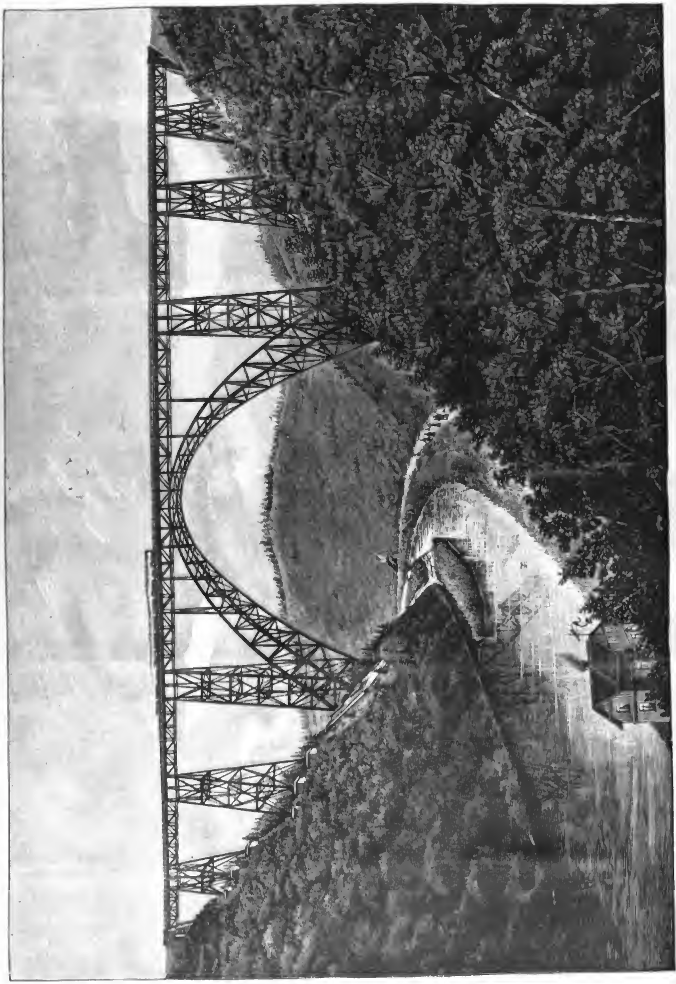
Benzole	400	c. cm.
Aceton (pyroacetic spirit)	400	"
Alcohol (absolute)	100	grm.
Sandarac	100	"

The solution is to be warmed in a water bath and filtered, the negative can then be coated without previous warming.

Retouching Varnish for Negatives.—

(a)	Alcohol	80	c. cm.
	Sandarac (pulverized)	15	grm.
	Turpentine	5	c. cm.
	Oil lavender	4	"
(b)	Alcohol	32	c. cm.
	Ether	2	grm.
	Camphor (crushed)	5	"
	Water	10	c. cm.

Both solutions are to be mixed several days before wanted, then decant and filter. The hardness of film increases with time.



THE RAILWAY BRIDGE OVER THE WUPPER VALLEY AT MUNGSTEN—305 FEET HIGH.

THE MUNGSTEN BRIDGE.

ON the day of the hundredth anniversary of Emperor I a peculiar fête was celebrated in the Rhine province. On that day the final touch was put to the bridge over the Wupper Valley at Müngsten.

The imposing structure was gay with numberless flags, and in the hours of the forenoon, accompanied by the joyful strains of a band, a procession of one hundred and twenty workmen approached. At their head were the directors and chief engineers of the Nuremberg company that had undertaken the building of the bridge and other great technical men. At the giddy height, in the middle of the vast parabola, a halt was made, and with the words, "To advance the common weal, to facilitate the traffic and in appreciation of the technical art!" the last three rivets were inserted. Then all joined with full vigor in the chorus of the well known hymn, "Nun danket alle Gott," and finally a good drink of beer from a mighty cask was enjoyed.

The total length of the bridge is 1,600 feet; the span of the arch is 524 feet; the breadth of the supports, 91 feet.

The pillars at the ends of the arch are 215 feet high; those on the banks, standing 98 feet and 147 feet apart respectively, are 151 feet and 79 feet high. The construction for the double tracks, which rests on the pillars, etc., is 19 feet high. The four abutments for the arch cover a total area of 3,767 square feet, and the sixteen stone bases of the four pillars on the banks 1,967 square feet.

In dimensions this bridge is, on the European Continent, surpassed only by the Garabit viaduct in southern France, which is built similarly, but rises 400 feet above the valley, and whose arch has a span of 541 feet.

The construction of the Müngsten bridge was begun from either side in the summer of 1893, and after all but the main span had been completed the free assembling of the span was commenced in 1896, in a manner never before attempted in practice.

The pillars on each side were connected by means of steel cables 3½ inches in diameter and were fixed by anchorage on the rock by means of hydraulic power.

Rotary cranes placed on the extremity brought ready mounted parts of 8 to 12 tons weight to their place of destination, where they were held suspended by ropes and mounted from travelling scaffolds. In this way the work progressed along the pieces added, and expensive scaffolding was avoided.

Unfortunately, some accidents are to be recorded as having taken place during the building, as, in spite of all precautions, three workmen found their death through falls from the structure. The opening of the new railway line Solingen Remsheid was intended to take place on July the first, and so a direct connection between the grand duchy of Berg and the lower Rhine is made.—Illustrirte Zeitung.

PUNCHING AND SHEARING MACHINES.

WE represent herewith a combined punching and shearing machine, and a simple shearing tool for profiled iron and steel, both manufactured by Mr. John Cameron, of Salford. The first of these interests more particularly ship builders, boiler makers and manufacturers of metallic framework. At its right it carries shears, at its left a punch, and in front a double punch for forming in the iron plates or the irons that constitute the carlings resting upon a vessel's floor timbers, or, if need be, in the latter themselves, the conduits arranged at the bottom of the hold to facilitate the circulation of water and allow it to flow toward the bilge pumps.

One of the punches is 3 inches in diameter and is capable of piercing carlings three-fourths of an inch in thickness. The other, whose rectangular section measures 2·25 inches by ¾ of an inch, serves for forming delivery channels in plates 0·9 of an inch thick. The hollow or overhang of the two branches of the frame is equal in both cases to 21 inches.

The two punches are capable of being actuated separately. They are used in rotation, and this dispenses with changing the punches and prevents the loss of time caused by this operation in machines provided with a single punch.

The punches are mounted in a strong cast steel carrier bolted to a cast iron slide actuated by the eccentric of a steel shaft. The rear part of the frame of this double punch is carefully trued, dovetailed together and bolted to the front of the principal machine. The punch placed at the left of the latter is capable of forming holes 1½ inch in diameter in iron plates of the same thickness. Its soft steel slide is provided with a starting mechanism and is actuated by a cam device that gives the punch a quick elevation followed by a pause. The hollow of the frame measures 34 inches.

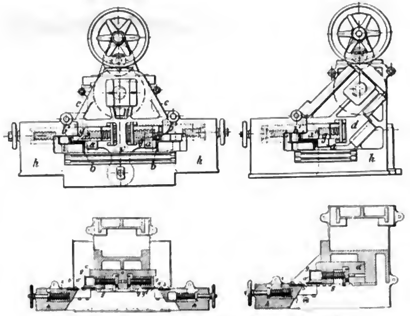
As to the shears placed to the right of the machine, those are capable of cutting plates 1⅛ inch in thickness at a distance of 34 inches from the edge, since the hollow of the frame is identical with the preceding.

The flywheels of these tools are of cast iron. At the place where the cams act, they carry tempered steel plates, and, at the front, coupling rods that serve to elevate the punches.

To the third face of the whole, that is to say, to the back, is bolted the steam motor that actuates the three tools. The whole weighs twenty-nine and a half tons.

The use of special machines for shearing or rapidly and cleanly cutting profiled iron and steel, at right angles or according to any degree of obliquity, is as indispensable in shipyards as at points where large iron frameworks or bridges are under construction.

DOUBLE TYPE. SIMPLE TYPE.



HORIZONTAL SECTIONS ACCORDING TO THE AXIS BLADE CARRIER SLIDES.

FIG. 2.—SHEARING MACHINE FOR Z IRONS.

The methods employed must not only assure a clean and accurate cut, but also prevent any distortion at the extremities of the pieces acted upon. They must also permit of passing, without complication or loss of time in regulations, from one dimension to another for the same profile and from an angle iron to an I iron, or from the latter to a U or a Z iron, according to the needs of the moment.

Mr. Cameron has devised several types of machines to this effect, all of which are identical in principle and consist essentially in the use of a flat blade cutting by its edges and presenting either a central piece or two lateral pieces that first enter the metal and prepare the way for the oblique cutting edges, which penetrate the metal progressively up to a complete shearing.

This blade operates between three pairs of counterblades fixed permanently in the base of the machine, which, at this place, presents a wide rectangular cavity. Two of these pairs are vertical and at right angles with the third, which is consequently horizontal. They thus extend along three sides of the cavity in the base. Moreover, one counterblade of these pairs is in front of, and the one that corresponds to it behind, the movable blade, and between them there is sufficient space to allow the latter to pass. The blade, in its descent into this sort of matrix, acts after the manner of a cutting punch upon the beam to be sheared, and removes therefrom a band of metal of the same width as the latter.

It is possible also to cut Z irons with these machines, but in this case the wings, during the operation, necessarily undergo stresses that tend to distort them.

This tendency, moreover, is so manifest that, for profiles of this kind, Mr. Cameron has devised a special shearing machine.

The two models of machines, a double and a simple one, that have been devised for this purpose are shown in Fig. 2. They are characterized by the use of two movable blades, a and a', that operate conjointly with two fixed counterblades, b and b'. In the double shears, a set of blades is arranged on each side of a piece, c, which is jointed at its lower part to the base, h, and is moved upward by the eccentric of a central shaft that receives its motion from spur gears actuated by a belt or by a special motor. The driving mechanism is identical in the simple shears, but its eccentric shaft actuates a frame, d, that slides in the base and carries a simple set of blades.

One of the movable blades, a, is fixed directly to the piece, c, or to the frame, d, while the other, a', is carried by the slide, g, which is regulatable by means of a screw and nut. A similar arrangement is given to the counterblades, b and b'. The first is stationary, while the second is mounted upon a slide, l, which may be displaced by a screw carrying a maneuvering hand wheel. The operator is thus able to regulate the position of the blades, a' and b', according to the height of the web of the Z iron. The cavities formed in the base for the passage of the iron to be cut, as well as the form of the slides, l and g, permit of giving the oblique position that corresponds to the angle of cutting.—Revue Industrielle.

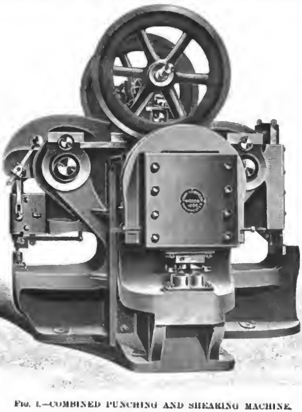


FIG. 1.—COMBINED PUNCHING AND SHEARING MACHINE.

ON his new Arctic expedition Lieut. Peary intends to take with him not only Esquimau men, but also women. The Esquimau is a pronounced family man, and prefers his wife to the North Pole.

BRITISH VERSUS AMERICAN MANUFACTURED PRODUCTIONS.

We are accustomed to hear it said that the American people are a people of great inventive genius; that they are more adaptive, and possessed of greater mechanical skill than our own people; and that they are destined in course of time to become the mechanical engineers and manufacturers of the world. No doubt the American machine tool makers and locomotive builders have made progress during recent years. But they have now had a considerable time to get their hands in, and should be able, if ever they are to make headway against European countries, to make it now. They have cheap raw materials, fairly cheap labor, home protection, and other elements in their favor, and yet they only export machinery and motors of all kinds to the value of about two and a half millions sterling a year, as compared with an average of about six times that value exported from the United Kingdom under the same heads. Nevertheless, the United States are undoubtedly "on the make," and very much in earnest. The American people have made up their minds to take possession of every market open to them, and hence it is not likely to be an unprofitable study if we seek to find out what they are doing, or have already done, that may affect our own mechanical industries.

The most important item in the list of American manufactured exports for a number of years past has been locomotive engines. The locomotive industry has assumed such large proportions in the United States that the home requirements, vast as they are, are totally insufficient to keep it employed. The number of locomotives exported from the United States has increased from year to year, until it is now between five and six times what it was six years ago. In other words, during that period the number of locomotives exported has increased from about fifty per annum to over three hundred. American locomotives are now annually exported to Russia, China, Japan, South and Central America, Canada, our Australasian Colonies, Cuba and other countries.

The amount of labor expended upon a locomotive engine is considerable, probably 75 per cent. of its total cost. Labor, however, is not a cheap commodity in the United States—certainly not cheaper, in nominal value, than in our own country. And yet the cost of building locomotive engines must be less in America than in Great Britain, or we should not witness a larger demand for American locomotives than for those built at home. The difference of cost must, moreover, be mainly a question of labor, for none of the materials of construction, on an average of the last ten years, have been cheaper on the other side of the Atlantic than on this side. Nor, when we speak of labor, do we necessarily mean that the American is a better or more hardworking artisan than the Englishman or Scotchman. It is not so much a matter of hard or intense labor as it is a matter of type. American locomotive builders, as a rule, adopt certain types, and stick to them. English builders, on the contrary, build a hundred different types to meet the fads of as many different locomotive engineers, many of them having the long purses of plethoric railways to draw upon, and caring little for economy so long as they can get their ideas tested to demonstrate the possibilities of special results.

Another point that greatly favors the American locomotive builder—and, indeed, the American manufacturer generally—is the fact that he not only sticks to particular types, which renders duplication easy and inexpensive, but he has a much larger and more steady market to rely on, and is, as a rule, more steadily employed than the British locomotive builder. This counts for much in reducing the heavy item of standing charges. The difference between one establishment working full time and another establishment working only half or three-quarters time is all the difference between making a profit and incurring a loss at a given schedule of prices. A further manifest advantage is gained by the American system of manufacturing on a large scale. Some of the American locomotive works—such, for example, as the Baldwin and the Schenectady—are, in point of size, far ahead of any similar works in this country, although we are prone to boast of such works as Neilson's, Dubs', Beyer & Peacock's, and the Kitson Works, at Leeds. We all know that if a factory is producing a thousand copies of the same thing it can do so much more economically than if it produced only fifty or a hundred, and herein, again, the works of the United States possess a notable advantage, alike in buying and in selling. Finally, in reference to locomotive engines, it has been claimed again and again that the American types are simpler, more powerful relatively to cost, and otherwise better than our own. We do not admit the truth of such claims, of course. Locomotive engineers of the first rank are continually debating this point, and it is still unsettled. But there must be those in all foreign countries that buy American locomotives who are disposed to prefer American types, or we should not see those types make the headway which they have done. The Baldwin Works alone have produced from first to last upward of sixteen thousand locomotives, and are represented in most of the civilized countries of the world. No locomotive works in Great Britain have, as yet, come anywhere near this record.

The observations which we have applied to the special conditions of American locomotive works apply, mutatis mutandis, to the manufacture of machine tools, of which the Americans now export four times the volume and value that they did ten years ago. During the last two years this branch of American export business has greatly advanced. This increase is largely attributed to the growth of the cycle industry in Europe, the American machine tools being imported for that class of work especially, although they are making headway in other directions. In one case fifty automatic screw machines by the Cleveland Machine Screw Company were ordered in one lot and to go into a single plant, and whereas in former years the trade consisted mostly of orders for single machines, or at most a very few machines in any one shop, it now often takes the form of complete equipments for the production of a certain machine or article. During the past year business is said to have been so good with them that they have been under no necessity of soliciting orders, but people have for the most part pressed to know how soon certain machines could be delivered. The growth of this business is the more annoying because, as a recent writer has pointed out, there is nothing in these tools which our native mechanics could not have produced if they had only thought of it. It is hard to account for this higher perfection of light machine tool making on the other side of the Atlantic. We are apt to consider that in a new country things are inclined to be haphazard and makeshift, but we must not forget that the engineering history of New England extends almost as far back as that of Old England. The earlier British engineers perfected the standard machine tools, and the engineering industry of the country has been so great that makers have not been forced into what are known as "special lines." When the heads of firms find they can make a good income by selling the same thing over and over again, they do not seek fresh combinations—unless, indeed, they have a natural love for designing. It may be that it is here that the New Englander has now the most considerable advantage. In the past many of our own machine tool makers were men who were brought up in the shops—mechanics, made into business men and heads of firms by the force of circumstances, but still mechanics. They had mastered their craft in the school of necessity, and loved it for its association with early days, and as a means by which they reached prosperity. They sent their sons to expensive schools, where the spirit of mechanical ingenuity has been an unknown thing, classics and the politer branches of learning being considered all important. The result is found in our failure to keep pace with those who have been trained in a sterner school.

One of the largest importers of American machine tools is Mr. Charles Churchill, who says he has encountered very little disposition or inclination in England to copy American machine designs. This may be due not only to the Englishman's inclination to have and to embody his own ideas in machine construction, but also to the fact that the prices at which American machine tools are sold in Great Britain discourage attempts to compete with the same machines, since it is readily seen that in order to produce similar machines at the same price a similar plant must usually be put down for manufacturing them, and with little hope of producing them at the same or lower cost.

For more than thirty years Mr. Churchill has been selling in England all sorts of drill and lathe chucks of American manufacture, yet, so far as he knows, there is not a single American chuck maker in England. American steel balls are also making headway, and orders for over twenty million American balls were placed there in 1896. It is believed that over two hundred Cleveland Machine Screw Company's automatic screw machines were installed in Great Britain last year. Another American product that seems to meet with a very favorable reception is the gas furnace of the American Gas Furnace Company, of which Mr. Churchill is agent.

Within the last few years the British have lost a large part of the industry of manufacturing steel tubing, of which we formerly exported large quantities to the United States. Colonel D. L. Cockley, vice-president and general manager of the Shelby Steel Tube Company, may be said to have founded this industry in the United States. In a chance conversation he learned that bicycle manufacturers were using an immense amount of steel tubing, all of which was imported. The two companies at this time in operation in England were the Weldless and Credenda. Two representatives of the Shelby Company were detailed on a special mission. It required persistent ingenuity to gain entrance to one of these steelworks. Disguised as a workman one of the representatives finally accomplished the task. Eventually, Hudson & Gay, tube drawers, allowed them to make sketches of their works and operations. The English preceptor of the tube industry declared that sizes less than three-eighths of an inch and larger than one and three-fourths inches could not be made; but at the works of the Shelby Tube Company, now the largest in the world, it is turned out in sizes ranging from one-eighth of an inch to as large as three inches in diameter, in gage from 1 to 30, English standard. The metal used is steel billets or blooms, imported from Sandviken, Sweden. Large annealing ovens, fed by gas, soften the tubes after each drawing, the final pulling giving the material the proper temper. Numberless slowly revolving hydraulic-like cogwheels, with endless chains of immense power, do the stretching of the steel tubes when cold.

So far as the miscellaneous exports of iron and steel products are concerned, the statistics of the ten years ending 1895 show a remarkable advance as set out in the table that follows:

EXPORT OF LEADING DESCRIPTIONS OF AMERICAN MANUFACTURES IN IRON AND STEEL, 1886 TO 1896.

Year	Steel plates and sheets, 1=1,000 lb.	Steel rails, 1=1,000 tons	Wire, 1=1,000 lb.	Bar iron, 1=1,000 lb.	Steel ingots, etc., 1=1,000 lb.
1886.	0	4	8,036	1,519	272
1887.	564	2	9,612	2,131	134
1888.	619	5	12,734	1,508	207
1889.	57	7	16,420	1,549	506
1890.	484	9	21,529	2,087	269
1891.	145	16	25,000	2,400	597
1892.	243	8	36,059	2,854	866
1893.	654	15	42,798	2,768	664
1894.	1,395	16	44,778	6,081	1,145
1895.	2,119	10	61,083	7,801	6,875

Besides the above the United States export quantities of pig iron, band, hoop, and scroll iron, castings, car wheels, nails and spikes, saws and tools, stationary engines and boilers, and stoves and ranges. The enumerated exports of iron and steel have increased from a value of over two and a quarter million dollars in 1885 to nearly seven and three-quarter million dollars in 1895. During 1896 still more notable progress has been made, and we are almost afraid to face the figures for the year 1897, which, as those published in the Review have already shown, has been making industrial history for the United States at a very rapid rate.—The Iron and Coal Trades Review.

BABBITT METALS.

By C. Vickers.

"Genuine" babbitt is composed of a small quantity of copper, added to tin and antimony. No lead is used, for the adjective "genuine" is applied especially to distinguish it from the cheaper grades containing lead.

There is considerable temptation to adulterate it with lead, owing to the difference in value of lead and tin; one pound of lead added to 100 of "genuine" makes a gain of about 18 cents. The character of the alloy would not be greatly altered, but when the purchaser pays for the best he certainly has a right to expect it. Fortunately, it is easy to detect such adulteration; take a piece and use it for a pencil; if it makes a mark, then it contains lead, as a small amount of lead added to tin causes the latter to mark paper. The following proportions may be used in making this alloy:

No. 1.	Copper	4 lb.
	Tin	8 "
	Antimony	8 "

This forms the hardening, as it is called. First melt the copper, add the tin and afterward the antimony; remove from the fire and let cool down to a dull red heat, then add 16 pounds more tin to increase the fusibility of the hardening. This makes 32 pounds hardening, add this to 64 pounds more tin—the proportions of tin to hardening thus being two to one. The additional tin should be melted separately in a kettle or suitable vessel, and the hardening added either in ingot form or direct from the furnace; in the latter case be sure the tin is all melted, otherwise an accident might occur by the hot metal from the furnace falling on the damp end of a projecting ingot.

To prevent loss by oxidation, the contents of the kettle should not be heated much above the melting point. In cases where a cheaper composition is desirable, the following can be recommended:

No. 2.	Genuine hardening	32 lb.
	Tin	64 "
	Lead	98 "

This forms a good alloy; another one is:

No. 3.	Hardening	16 lb.
	Tin	50 "
	Antimony	20 "
	Lead	80 "

In mixing this alloy, first melt a portion of the lead, say 40 pounds, in the kettle or in a crucible in the furnace, bring to a dull red heat, add the antimony, in small pieces, when melted add the balance of lead. Do not attempt to melt the antimony without the lead bath, as it is a volatile metal and there would be loss from oxidation.

In making all alloys containing hardening, a furnace is necessary, on account of the heat required to melt the copper. The following mixtures contain no copper, and are fairly good compositions:

No. 4. For hardening, take	Lead	145 lb.
	Tin	40 "
	Antimony	20 "

Melt 145 pounds lead and 40 pounds tin and add 52 pounds hardening.

No. 5. For hardening.	Lead	48 lb.
	Antimony	26 "

Add this amount to 132 pounds lead. The hardening is used in this merely to form a bath for the antimony, and any portion of the 200 pounds lead may be taken. This is cheap and soft.

Another cheap composition is formed as follows, and is known as "hard lead;"

No. 6.	Lead	80 lb.
	Antimony	20 "

Hard lead is a better metal than No. 5. It is largely used for lining car journal bearings. It may be improved by the addition of tin as in the following:

Hard lead	100 lb.
Tin	100 "

This is given as an illustration. A great variety of alloys can be made by taking hard lead as a base and adding tin in varying quantities.

Zinc is sometimes added to cheap alloys. It has a tendency to form unsightly ingots, owing to the formation of bubbles on the surface. It should be kept out of strictly high class babbitt. It has been suggested that the addition of aluminum improves babbitt metals. But, while this may be true, the writer does not consider that the improvement will be sufficient to pay for the increase in cost. Bismuth is also sometimes used, but it possesses no advantage over antimony and is more expensive.

Before pouring into ingots, the dross which forms a scum on the surface of the liquid metal should be skimmed off and saved. The percentage of dross may be lessened by the use of a flux. Resin, tallow, or grease of any kind is a good flux for babbitt alloy. When any considerable amount of dross has accumulated, it may be melted by adding resin and small quantities of crude sal ammoniac. The flux must be thoroughly mixed into the pasty mass, until it liquefies, and the dross floats on the surface in the form of a greenish dust. It may then be skimmed off and the metal poured into ingots.—Machinery.

The damming of the Rio Grande River by an English corporation for irrigation purposes is objected to by the Mexican government, in a communication to the State Department of the United States, as seriously interfering with navigation, says the Engineering News. The proposed dam was to be located on the American side, at Elephant Butte, New Mexico, and authority for its construction was granted by the Secretary of the Interior, under the Desert Land Laws. Attorney General McKenna has now decided that the construction of the dam would injure persons along the Mexican side of the river, and would therefore be a violation of international law. He has, consequently, instituted civil and criminal proceedings to stop the work. The projected international dam at El Paso would also become useless if the Elephant Butte dam were erected, according to a report made to the War Department by Col. Anson Mills, U.S.A., and international boundary commissioner.

THE INTERNATIONAL GEOLOGICAL CONGRESS IN RUSSIA.

THE International Geological Congress may be said to come of age this year, for it was founded at Philadelphia in 1876, at a meeting held under the presidency of the veteran James Hall. The first organized session was held at Paris in 1878, and since then meetings have taken place at Bologna, Berlin, London, Washington, and Zürich. The seventh session is to be held at St. Petersburg, with Prof. A. Karpinsky as president.

The ordinary meetings of the congress will be held in the rooms of the Imperial Academy of Sciences at St. Petersburg. There will be a preliminary assembly of the members on August 28, the formal opening will take place on the following day, and the meeting will terminate on September 4. According to the Russian calendar, these dates will be twelve days earlier, namely, August 16, 17, and 23.

The meetings will extend over eight hours. From 9 till 10 a. m. the committees of the congress will deliberate; from 10 till 2 p. m. there will be discussions on questions proposed in the programme of the organizing committee. One hour is then set aside for visits to museums and to the exhibition of maps, sections, books, specimens and instruments—possibly some members may then take the opportunity of obtaining lunch. From 3 to 5 o'clock papers of a general character will be read, and these will be so arranged that only one branch of geological science will be discussed each day.

The organizing committee will reopen the subject of the unification of geological nomenclature. The larger divisions of the earth's history must be based on general paleontological characters, and in defining the several systems attention will be specially given to the study of pelagic life and the evidences of organic evolution. In order that a system be well established it must be capable of subdivision into stages characterized by well marked pelagic faunas, and these should have a European or equivalent value. It is recognized that substages have only a regional value, while minor divisions have but a local character, and with these the congress does not deal. The divisions, in short, which the assembly will be called upon to discuss are those of geological time, based on the occurrence of successive groups and zones of fossils; the purely stratigraphical divisions are essentially regional or local, and they may reasonably be left for each country to fix according to its own necessities; for they are all important in the interpretation of the structure of a district, in determining its economic resources, and in explaining the origin of its scenery. On the other hand, when we seek to trace out the history of the great changes which the earth at large has undergone, the more comprehensive life divisions are all important; and these only can be universally applied, and, we hope, universally adopted. It is true that life divisions are no more to be rigidly defined than are stratigraphical divisions in the rocks, but fossils are the only guides for correlating the formations in countries far apart. There should be no serious disagreement among geologists, at any rate with regard to the principles of correlation; and there is no reason why, after full and friendly discussion, a particular nomenclature should not be generally accepted. It need not interfere with our local divisions, any more than great chronological terms, if applied to human history in general, would interfere with our own time divisions marked by the reigns of successive monarchs.

The organizing committee will also deal with the subject of petrographic nomenclature, in the hope of reducing the number of terms now used, and of preventing unnecessary names being introduced. In petrology, as in paleontology, one is nowadays in constant need of a dictionary or glossary, or table of synonyms, to understand the various names of rocks or rock structures and fossils.

The scheme for excursions in connection with the congress is an elaborate one. There will be excursions both before and after the ordinary meeting, and those who have time and money will have grand opportunities of visiting many parts of the Russian empire in Europe.

Prior to the congress there will be three excursions; namely, to the Ural regions, to Esthonia, and to Finland. The Ural excursion is timed to take place between July 28 and August 27. There will be a general gathering of the party at Moscow on July 29, and those who join are advised to take thick boots, warm clothing, and waterproof cloaks, for there will be rough walking as well as long journeys in open carriages and on horseback. Messrs. Nikitin, Tschernyschew, Arzruni, Karpinsky, and Stuckenberg will act as leaders. The party will take train to Riazan, and thence journeying to Syzran, on the Volga, they will cross Jurassic, Cretaceous, and Tertiary strata. Thence from Samara to Oufa, Permian and Triassic rocks will be traversed, while onward to the Ural Mountains the party will pass over Carboniferous, Devonian, and Siluro-Cambrian strata, which present evidences of considerable metamorphism, and which, together with various schists, are penetrated by numerous eruptive rocks. The region is famed for its metalliferous deposits, and various mines in rocks bearing gold, copper, and manganese will be visited, as also will be the imperial stone-cutting works at Ekatherinebourg. The return journey will be made by Perm, Kazan, and Nijni-Novgorod.

The excursion into Esthonia, August 13 to 27, under the direction of M. Schmidt, will be by rail to Reval, on the Gulf of Finland, and then a visit will be paid to the Isle of Dago, when attention will be given to the fossiliferous Upper and Lower Silurian rocks.

The excursion to Finland will be made under the guidance of M. W. Ramsay. The members will assemble at Helsingfors on August 21, and return to St. Petersburg on August 28. Tammerfors and Lavia will be reached, and attention will be directed to the glacial phenomena and the various crystalline rocks.

After the meeting of the congress is over, the principal excursion will be to the Caucasus, leaving St. Petersburg on September 5, and arriving at Moscow on the following day. The excursion party will then be divided into three sections, A, B, and C. Section A will be conducted by Messrs. Nikitin, Tiouraw, Tschernyschew, Loutougin, Rongnéwitsch, and Konchin. Leaving Moscow, and traveling by Podolsk, the route will be over Jurassic, Carboniferous and Devonian rocks, and on the Cretaceous strata of Koursk and Kharkow. Thence the party will proceed to Rostow, at the head of the Sea of Azov, examining a mercury mine and certain mineral springs, and ultimately reaching Wladikavkaz, on the northern side of the Caucasus Mountains. Section B will start, under the guidance of Messrs. Pavlow and Amalitzky, from Moscow to Nijni Novgorod, across Jurassic and Triassic formations to the Cretaceous rocks of Simbirsk on the Volga. Journeying southward, they will visit asphalt quarries, and by means of steamer and railway they will proceed along the plains of the Volga and the borders of the Kirghis Steppes to Astrakhan and Wladikavkaz. Section C will be under the direction of M. Sokolow, and will journey to Kiew, on the Dnieper, paying especial attention to the Tertiary and Post Tertiary deposits. Following the river to Alexandrovsk, the party will ultimately join the two other sections at Wladikavkaz by way of Rostow.

Thus united, the whole party will proceed across the mountainous country to Tiflis, under the direction of M. Loewinson-Lessing, some few members separating for a while to examine a glacier under the guidance of M. Kolenko. Tertiary, Cretaceous, Jurassic, and metamorphic rocks will be seen. From Tiflis all will proceed to Baku, on the borders of the Caspian, and thence separating into two portions, they will traverse the mountainous region from east to west, and unite again at Rion. Some may spend a week in the Caucasus, examining the Maunisson glacier; others will have an opportunity of visiting Mount Ararat.

Those who desire to still further continue their field studies among Cretaceous and Jurassic rocks may take part in a general excursion into the Crimea. They will proceed by steamer from Batoum to Kertch, and eventually, on October 5, there will be a reunion of all the remaining excursionists at Sébastopol. Thus will terminate the great programme of expeditions planned by the geologists of Russia.—H. B. W., in Nature.

THE BAKERIAN LECTURE—ON THE MECHANICAL EQUIVALENT OF HEAT.*

THE purpose of this research differs essentially from that of any previous research on the mechanical equivalent of heat. In order to diminish the loss of heat by radiation, as well as to obtain the equivalent for water in the neighborhood of ordinary temperatures, the ranges of temperature over which the previous dynamical measurements have been made are greatly less than the standard interval between the physically fixed points of temperature to which all thermal measures are referred, and so have of necessity involved the use of scales, the intervals of which depend on the constancy of the relative expansions of such substances as glass, mercury, and air. On the other hand, in this research the object has been to determine the mechanical equivalent of the total heat necessary to raise the temperature of water over the standard interval of temperature, and thus to obtain directly the equivalent of the mean specific heat between the freezing and boiling points.

This undertaking is the result of the occurrence of circumstances which afforded an opportunity such as might not again occur. This consisted in the facilities offered by the appliances which formed the original equipment of the Whitworth Engineering Laboratory, in 1888, the more essential of these being an engine of 100 H. P., working one of Prof. Reynolds' hydraulic brakes. This brake maintains any constant moment of resistance on the engine shaft, independent of the speed, all the work done being converted into heat, which appears in the rise of temperature of a steady stream of water flowing through the brake, the magnitude of which stream is independent of the load on the brake or the speed of the engine, and is under independent control.

The existence of the Manchester town's water, of a purity expressed by 3 grains of salts to the gallon, conveniently distributed in the laboratory, as well as auxiliary power, both steam and water.

Although unconsciously, the research was really commenced in 1889, when, without any intention of making a determination of the heat equivalent of the work done on the brake, but solely for the purpose of verifying the mechanical balance of the brake, provision for thermal measurements was added, and a system of trial instituted, in which the object sought was only that of obtaining consistent results over definite portions of the scales of uncorrected thermometers, eliminating the errors resulting from radiation by taking the differences of two trials. In these trials the temperature ranged from 40° to 50° F., and their development was continued over two years. Then it occurred to Prof. Reynolds that by the same method the great facility which this brake was then seen to afford would be available for the independent determination of the mechanical equivalent, if it could be arranged that water should enter the brake at the temperature of melting ice and leave it at that of water boiling under the standard pressure. Since then all that would be required of the thermometers would be the identification of these temperatures, and with a range of 180° the error in scale over one or two degrees would be comparatively of small importance. At first the difficulties seemed formidable; but on trying by gradually diminishing the supply of water to the brake when it was absorbing 60 H. P., and finding that it ran steadily under control of its automatic gear till the temperature was within three or four degrees of boiling, he further considered the matter, and during the next two years convinced himself of the practicability of the necessary additional appliances by preliminary designs. These consisted of:

(1) An artificial atmosphere or means of maintaining a steady air pressure of ½ atmosphere in the air passages of the brake.

(2) A circulating pump and water cooler, by which the entering water, some thirty pounds a minute, could be forced through the cooler into the brake at a temperature of 32°, having been cooled by ice from the temperature of the town's main.

(3) A condenser by which the water leaving the brake at 212° might be cooled down to atmospheric temperature before being discharged into the atmosphere and weighed.

(4) Such alteration in the manner of supporting the brake on the shaft as would prevent excess of leakage from the bushes in consequence of the greater pressure of air in the brake, since not only would the leaks be increased, but, when the rise of temperature was increased to 180°, the quantity for any power would be diminished to one-sixth of that for a rise of 30°, so that any leakage would become six times the relative importance.

(5) Some means by which assurance of the elimination of the radiation and conduction could be obtained, as with a temperature of 140° F. above the laboratory these would probably amount to 2 or 3 per cent. of the total heat.

(6) Scales for greater facility and accuracy in weighing the water with a switch actuated by the counter.

(7) A pressure gage or barometer by which the standard for the boiling points might be readily determined at 3° or 4° F. above and below the boiling point, so as to admit of ready and frequent correction of the thermometers used for identifying the temperature of the effluent water.

(8) Some means of determining the terminal differences of temperature and quantities of water in the brake, which would be relatively six times as large as with 30° rise.

These preliminary designs apparently demonstrated the practicability of the appliances, and also the possibility of their inclusion in the already much occupied space adjacent to the brake. But there remains still much to be done in the way of experimental investigation in order to obtain the data for proportioning the appliances.

In July, 1891, Mr. Moorby having undertaken to devote himself to the research, the experiments necessary for the appliances were at once commenced, and these, together with the construction of the appliances and then standardizing, and preliminary experiments while this was in progress, occupied till February, 1896, when Mr. Moorby commenced the main experiments, which were continued into July, 1896.

In these experiments the time of running was 62 minutes, the speed 300 revolutions a minute, on the speed gages. Observations of speeds, of the temperature of the inflowing and effluent water, and of the temperature of the air were made every two minutes. Observations of the slope of the temperature of the shaft were made every eight minutes.

The temperature of the inflowing water varied from 32·5° to 34°, and that of the effluent from 210° to 214° F. The effluent water was cooled to 85° before entering the tank, on the scales in which it was weighed, weighings being taken before and after each trial.

The temperature of the metal surface of the brake being sensibly the same as that of the effluent water (212°), and by taking the difference in the work absorbed in two trials and the differences in the heats developed, the errors of radiation and balance in the brake were approximately eliminated, and in order to complete the elimination the coefficient of radiation was approximately determined, so that a correction might be applied for any residual differences of temperature as observed, and in the same way with the slope of temperatures. Farther assurance was also obtained by making some trials with the brake naked and others with it covered, so as to reduce the loss of heat to one-fifth; and, in the same way with every circumstance which could affect the result trials, means were taken to vary the circumstances in different series of trials, so as to obtain an estimate of the limits of error. All the appliances were most carefully standardized; and taking all the limits of error into account, the limit of the sum was less than 0·0003.

In all fifty-two trials were included in the final result. Of these

25	with loads on the brake of	1,200	ft. lb. at	70	H. P.
21	"	"	600	"	35	"
6	"	"	400	"	23	"

From these, twenty-five separate determinations were made of the equivalent subject to certain general corrections given below, which gave a mean value 777·91, and from this none of the separate determinations differed by as much as 0·2 per cent., which arranged in eight groups, according to the circumstances under which they were made, the greatest divergence from the mean was 0·05 per cent.

It was found impracticable to eliminate entirely from each determination the losses of heat due to radiation, conduction, leakage of water, etc., and so it was found advisable to determine what these losses were. This information was given by the trials themselves, and the necessary corrections were applied to each separate determination. As illustrating the extent to which the method adopted did eliminate these errors, it is interesting to remark that on the mean value of the equivalent determined, without taking these errors into account, the error was only 0·0192 per cent.

Certain final corrections, which had the same values for all trials, were made to the mean value of J, already given. These were introduced on the following various counts:

I. Length of the brake lever (0·00042).
II. Salts dissolved in Manchester water (0·00003).
III. Air dissolved in water used in the trials (−0·00021).
IV. Reduction of weighings to vacuo (−0·00120).
V. Varying specific heat of water (−0·00005).
VI. Pressure on thermometer bulbs (−0·00057).
VII. Work done against gravity (0·00007).
VIII. Engagement of counter (0·00001).

Their total effect was to introduce a correction factor (1 − 0·00125).

The mean corrected value of the specific heat of water between freezing and boiling points, as measured in mechanical units at Manchester, is found to be 776·94.

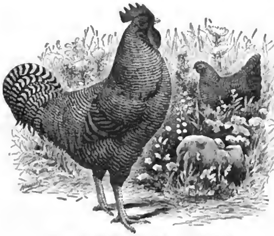
* By Prof. Osborne Reynolds, F. R. S., and W. H. Moorby. Read before the Royal Society, May 26.—Abstract from Nature.

A great boom in autocars is promised in Paris by next spring, the Exhibition year, 1900, being too far off to wait. A company promises to have at least 500 autocars on the streets of Paris by the end of the present year, and about 4,000 before next summer. It is stated that they will be worked by electricity stored in accumulators and the name "chauffeurs" has already been found for the drivers. One translation of that term is "bandits who burned people."

THE STANDARD VARIETIES OF CHICKENS.

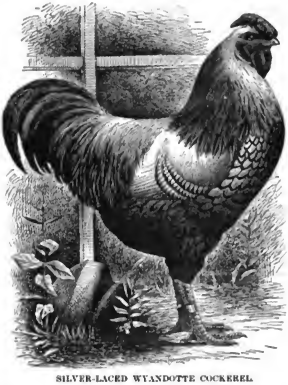
By JOHN MICHELS.*

ONE of the most interesting, and, no doubt, will prove the most popular bulletin issued for farmers by the United States Department of Agriculture, is



PAIR OF BARRED PLYMOUTH ROCKS.

FEATHERS OF BARRED PLYMOUTH ROCKS.



SILVER-LACED WYANDOTTE COCKEREL.

that relating to the standard varieties of chickens in this country, of which there are eighty-seven, besides a large number of promiscuous varieties.

Perhaps the most popular of the varieties, and the best to keep for general purposes, is the barred Plymouth Rock. It is of a grayish white color, regularly crossed with parallel bars of blue black running in straight, distinct lines throughout the entire length of feather. They are hardy, good layers, averaging eight to a pound. This is a practical bird and good for the market, and, at the same time, the most sought after

RED PYLE GAME COCK.

by the fanciers. Some of this variety has pure white plumage.

Next in popularity come the Wyandottes, as they have proved a great success. They were raised from the dark Brahmas, silver-spangled Hamburg and the French fowl Bredas. As their ancestors had feathers on their legs, it would seem to indicate they have Cochin blood in them. They weigh about a pound less than the Plymouth Rock, and are prolific layers, as they generally yield about fourteen dozen eggs a year. There are five varieties, and it is only a matter of taste which is the best. In color some are silver laced, others golden, buff, black, and some white. The average weight, when full grown, is 8½ pounds. The feathers are beautifully marked.

As a contrast to other poultry the tall, commanding figure of the Exhibition Game Cock is remarkable. For a long time Exhibition Games have been a favorite

SILVER DUCKWING GAME COCKEREL.

fowl in this country. By careful breeding for many generations, they have been brought to a high state of perfection. Their beauty is much praised, and their class is always well filled at the numerous shows. It should, however, not be thought that they are unprofitable fowls to keep, but are good for farm purposes. They are, as a class, splendid layers, excellent table fowls and good sitters and mothers.

We now come to the Cochins, of which there are four classes, of which the buff is most bred and popular. Some are pure white, others pure black. The feathering of the legs, feet and even toes is the well known characteristic of this variety, which gives it a rather grotesque appearance; but fanciers consider them very beautiful. They are hardy, good winter layers, but only fairly good table fowls.

This remarkable bird is one of the oldest varieties of poultry. Its ancestors can be traced back to the sixteenth century. They are a medium sized fowl, and the leading characteristic is, of course, the crest, which is composed of yellow feathers, and should rise well up in front, so as not to obstruct the sight, and fall over the back and sides in a flowing, even mass. The smaller the comb the better, and, if wholly removed, it is not considered a disqualification.

The Leghorns are the best known of the egg-producing varieties of the Mediterranean class. The Leghorn hold the same place among poultry that the Jersey hold among cattle. They are lively, active and the best of foragers, and will pick up a great part of their living during the year. They are the best layers, averaging 150 to 200 eggs a year. The eggs are pure white, and weigh about ten to a pound. Altogether, they are the most profitable breeds that can be kept on a farm, the cheapness of their keep allowing the raising of two Leghorns for the cost of one Asiatic. In shape they are graceful, body round and plump, broad at the shoulders and tapering toward the tail.

The Sultans are a recent exportation from Turkey. They were introduced into England in 1854, but reached America several years later. Considering their charac-

FEATHERS OF SILVER-LACED WYANDOTTE.

teristics, they might be classed as Polish, but their feet are feathered and they have a fifth toe. Their beauty is their chief recommendation, as they lay claim to modest usefulness only as layers, for they are too small for table use.

The Japanese bantam is white and is noted for the

* Late of the United States Department of Agriculture.

beauty of the tail, as well as for the graceful shape of the neck and breast.

Yokohama sends us this remarkable variety of fowl. The tail is about a yard in length. The Phœnix fowl is one of the myths of the Japanese religion, and is often seen in Japanese pictures. The Bulletin, from

SULTAN COCK.

which our pictures are taken, was prepared by Mr. George E. Howard, secretary of the National Poultry Association, under supervision of Dr. D. E. Salmon.

THE THEATER OF INSECTS.*

THE first zoological book printed in England was the "Theater of Insects," by Moufet in 1634. The title of the book would suggest that the author, after the manner of old Izaak Walton, was wont to moralize a bit over his studies of natural history. We fancy that he

BLACK-TAILED JAPANESE BANTAM COCK.

saw, as upon the stage, both tragedy and comedy in the lives and ways of the little known insect world.

The theater of insects differs from all other theaters in that its busy season comes during the summer months. Just as in the long ago, historical geology tells us that flowers and insects appeared in the world at the same period of time, so now in early spring the blooming of the first flowers announces the awakening of insect life. If during the last week of the month of May you visit a cold, damp woodland of Northern New England, your attention will at once be arrested by

BACK VIEW OF BUFF COCHIN COCK, SHOWING FULL FEATHERING.

the handsome and conspicuous blossoms of the hobble bush, or wayfaring tree. The large flower buds are formed the previous season, pass the winter wholly naked and open in spring with the appearance of the leaves.

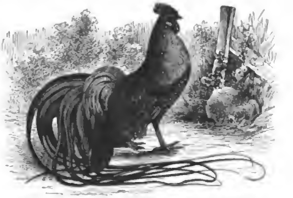
This shrub may be easily recognized by its straggling habit of growth, its drooping branches and the broad flat heads, or corymbs, of flowers of two different sizes. The center florets are small, greenish in color, and in autumn produce bright red berries; while the marginal ones, a single row of which surrounds the corymb, are large, white, and sterile. Their size has been increased at the expense of their power of producing seed, and as their use is to attract the attention of insects, they usually open some days in advance of the inner and smaller florets. But for them, the blossom would easily pass unnoticed amid the budding foliage, as may be easily proved by cutting them off. Since their conspicuousness is useless to themselves but of benefit to the community, they may be said to unconsciously play the part of benefactors.

A sort of barter or exchange is carried on between the flowers of the hobble bush and the insects, by which each is of service to the other. A small quantity of honey, in a thin layer, is secreted by the inner florets, and as insects pass quickly from floret to floret in search of this, their bodies become covered with pollen, and they repay the plant for the food they obtain by effecting cross fertilization. Let us carefully watch the flower on a sunny day and observe how successful it is in attracting insect visitors. I have taken upon it and have now in my collection three species of bees, one butterfly, a small brown species of miller, three hemiptera, five flies and seven beetles, or twenty species in all, a large number for the month of May. Butterflies are rarely met with, for as the honey is fully exposed and not concealed in a deep pit, as in the pinks, the flowers are adapted only to the visits of short-lipped insects such as flies and beetles. Upon the open flowers they can readily obtain both honey and pollen, and in consequence are the most frequent visitors.

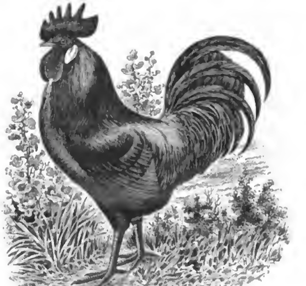
In gathering honey from the flowers of the hobble bush there would seem to be no possible danger to insects, and yet they not unfrequently meet with a tragic end. Here lying upon the flat top of the blossom is a dead fly. Lift it up and you will discover how it was killed. The head is firmly grasped by the mandibles of a white spider, which, rather than release its prey, permits itself to be dragged from its hiding place and deposited in your collecting box.

Except for a red lateral stripe on the abdomen, its color closely resembles that of the flowers amid which it lives, and of whose power of attracting insects it has learned to make use for its own benefit. I have never been able to observe this spider in the act of seizing insects, but I believe it catches them while they are sucking honey. A member of this same family of spiders also frequents the pyramidal flower clusters of the hard hack, and I have known of its capturing so large and strong an insect as the hive bee.

Bees puncture the two-lipped tubular flowers of the common skullcap (Scutellaria galericulata). In two instances a narrow slit was observed on the upper side of the curved corolla tube, and in a third case the whole upper portion of the tube was cut away, leaving the lips suspended by a mere thread. The buds while still quite immature are also punctured at the apex, usually on the under side. The piercing of nearly mature buds has been recorded of Lamium album, but never before, so far as known to the writer, of the skull-



LONG-TAILED JAPANESE GAME, OR PHŒNIX COCK.



SINGLE-COMB BROWN LEGHORN COCK.

BEARDED SILVER POLISH HEN.

* John H. Lovell, in Popular Science News.

cap. The perforation of the flowers of the Labiata by bees is, however, of common occurrence. Both the maxillæ and mandibles appear to be employed, the former for piercing and the latter for biting away the tissue, and both the humble and hive bees are known to make use of the holes in extracting honey.

If, after the manner of certain plants famous in myth and story, the impatiens (fitly, in this respect, named Touch-me-not) could speak, what a protest it would utter! For unknown centuries it has been developing the color and form of its flowers only at last to find its work in danger of being rendered worse than useless by a change in the habits of its bee visitors. It should, however, be mentioned that the flowers in North America are visited by humming birds, and I have also seen another smaller species of bee enter the flower in search of pollen.

COLOR IN ANIMALS—ITS CAUSES AND USES.*

ANIMAL coloration is either structural or useful. The brilliant colors of some of the minnows are of no actual use to the minnows, but due to some structural peculiarities.

Useful colors are such, for example, as cause an animal to resemble its surroundings—escaping its enemies or enabling it better to creep upon its prey.

An object through which light passes practically without absorption is transparent. Reduce or comminute that object to such condition that large quantities of light are reflected, it becomes white. A transparent piece of glass or ice, pounded into powder, looks perfectly white. The light is dispersed and disseminated in such a way that it no longer passes through, and we get the effect called white. Snow pressed into a solid block becomes transparent. We get glacial ice through the enormous pressure of snows accumulated year after year, that at the bottom of the glacier appears as pure, transparent ice. The binding oil globules in the cream break up the light, and we see the milk as white. Water it, and it turns bluish—more or less transparent.

In the white hair of the head we have the transparent shaft, and under the microscope this shaft air always appears black, though the effect to the naked eye is white.

History tells us of human hair turning white in the night. Long ago this was assigned to some acid secretion in the head arising through some tremendous nervous strain. This is wrong. It is probably due to the blood at the base of the hair forcing up air bubbles through the shaft, this producing disseminated light and the effect of white hair.

This power of changing the coloration of the hair can be utilized in a great many cases, as we find in Arctic animals, for a color protection.

Among structural colors we have the iridescence so commonly distributed through nature. The iridescence of the soap bubble arises from the fact that the bubble being very thin, some light is reflected from the outside of the bubble and some from the inside.

A microscopic examination shows the mother-of-pearl shell to be made up of very fine lines so closely put together that the white light is broken up into its prismatic colors, and we get the so-called "play of colors" or mother-of-pearl. Taking a very careful cast of mother-of-pearl shell with very fine lines, the wax will yield the same iridescence as the mother-of-pearl.

Some birds' feathers owe their color to this same cause—as in the iridescent spots on the peacock and the iridescent green color of the trochilus.

The casting of the skin in the case of the snakes is done entire; in the case of other animals, in large flakes or parts of the skin. In the reptilian casting the new and the old skins are separated by a very fine layer of hairs called "casting hairs," that seem to push up the outer skin while the lower one is forming, separating them so that the old will slide off when the process is ready to be executed.

The crabs in casting their shells exhibit the same curious arrangement of casting hairs which under the microscope appear as really worn off; but it is the lines of the bases of these hairs (which are arranged in rows) that in the reptiles break up the light as in the mother-of-pearl and give us the scale. In some cases these casting hairs have been retained in the animal and applied to a totally different object.

The gecko has curiously lobed feet cut up into ridges and each one covered over with microscopic hairs. It is an arrangement that serves as a sucker and is quite common in the animal kingdom. The fish that attaches itself to the shark has the same principle—a series of slats like a Venetian blind that will pull up and cause suction on the object to which it is applied; and these little casting hairs are of great value in holding the feet flat on objects, also to release the feet when it is necessary to let go. These little geckos are thus enabled to crawl all over ceilings and smooth, vertical rocks. They are common at Villa Franca, in the West Indies, and throughout the tropics generally.

The young gecko cannot hold on to upright surfaces until it has shed its first skin, prior to which shedding the casting hairs are lacking.

In a number of cases biliary salts are deposited in the skin of the animal for the production of the distinctive color.

An interesting change of color is going on in the Caucasian race. Russians, Danes, Norwegians and other northern tribes are characterized by light hair and blue eyes; while along the Mediterranean shores and in Southern Asia people have dark eyes. All the light races are gradually going out of existence; that is to say, there is a tendency for the Caucasian race to become dark, and this is probably based on the action of the liver. A northerner living in the tropics tends to torpidity of the liver; the biliary salts are not properly eliminated from the body and commence to be deposited under the skin. On the other hand, in cold climates, the liver is very active and the biliary salts are carried off and not deposited in the skin, hair and eyes; so we have the light, long hair and blue eyes.

Civilized races are producing a tropical climate throughout the year, and even when living in the extreme north live in a temperature of 70 to 80 degrees all the year round. This acts upon the liver, and the liver upon the skin; and these modern conditions are gradually driving out of existence the light haired and blue eyed races.

Some animals change their color at will. The color itself is always there; but by contracting certain of these pigment cells, and allowing others to expand, a temporary change can be effected. The chromatophores from the skin of a frog represent pigment cells. Some contracted and some expanded in different degrees of expansion will grade the animal in color, making it at times dull brown, at others green.

In the case of the chameleon, the chromatophores are supplied with actual muscles, giving them much more powerful and quick control over their color than most other animals. The chameleon can change to the brown of the bark or to the dark green of the leaves of the tree upon which it lives; but in those stories making the chameleon scarlet on occasion the writers have drawn upon their imaginations; because we know the animal could not produce scarlet.

The cuttlefish has the chromatophores very highly developed. Get hold of one of these or a squid on the sea coast before it dies. You can hardly see the spots upon it, some being as large as, others larger than, a pinhead. Irritate the animal, and you will find the spots closing up. It will become pale instantly, almost as soon as your pencil touches the animal.

The sole of the English coast, when placed upon a gravelly bottom, assumes the color of the bottom to a remarkable degree, this being a case of color protection whereby the animal has the power of making itself in exact harmony with its surroundings. Place the sole in an aquarium with light yellow sand, it would turn just that color; as I have often seen in the aquaria at Woods Holl. Take this same individual sole out of the aquarium and put him on a white porcelain plate, the chromatophores will contract down to the very utmost limit and make the animal almost white. The sole's under surface, of course, is always white.

A sole was found to be entirely out of harmony with the bottom over which it lived. Its color would be light when placed on a dark bottom, and dark when changed over a light bottom; and it was found later the animal was blind and there was no correlation between the surroundings and the chromatophores. Other specimens have been blindfolded and proof afforded that the harmonization was guided entirely by the animal's own eyesight.

Color has reference to the general color of an animal, while coloration means the pattern of color upon the animal, as striped or barred. The proteus has lost all the pigment of the skin, and it being transparent, the blood of the animal shines through and gives it a beautiful pink color—in this case a non-significant color.

In excitement, the wattles around the head and neck of the turkey become deep scarlet, due to the rush of blood to these parts, and gives it one of the sexual colors. The blushing on our own faces is due to some nervous emotion, producing partial paralysis of the muscles controlling the caliber of the capillaries, and these, being relieved of compression, becoming enlarged, an excessive flow of blood, with high color, results.

The polar fox has two general colors—white in winter and dark in summer—both very important to the animal. Formerly it was considered this was due to the fact that dark colors part more easily with their heat than do light colors; therefore, the animals dark in color would get rid of their heat; while in the winter the white acted as a non-conductor of heat, thus retaining it within the animal's body. This theory is now abandoned. The change of color is due to the action of environment, and probably is due not entirely to the action of cold.

The dark summer coat of the polar fox is in general harmony with the ground of the rocky Arctic regions where the sun has melted off the snow; the same thing when the animal becomes white and runs over the snow, when it is almost impossible to see it.

The lemming is a rodent common throughout northern Europe, Asia and North America. In Sir John Ross' northern expedition he kept a lemming in the cabin for a long time in winter. The animal retained its summer pelt of dark brown color in harmony with the rocks upon which it lived. In February he placed it in a cage on deck thirty degrees below zero. Next morning its cheeks and shoulders were patched with white, and at the end of the week it was nearly all white. The hair itself had actually turned white, and I suppose there was no reason to doubt the fact that it was due to the forcing in of air bubbles through the shafts of the hair, breaking up the light. Later on a growth of white hair came out from below, gradually replacing the hair that had been changed so suddenly. The cold of the winter really produced this white hair for the protection of the skin.

The ptarmigan displays this dual coloring, being snow white in winter and almost indistinguishable in the snow, while the summer-plumaged ptarmigan can be within two or three feet of the hunter and invisible. The male is quite conspicuous, but he is very shy and keeps away from his enemies. I remember gunning once in Greenland when some of these ptarmigans were located, and, after waiting awhile for a shot, we finally fired at the group, when right around us, within six feet, six of them flew up, unnoticed before because of the perfect harmony of their coloration with the ground. In watching those we were going to shoot, it was sometimes difficult to see them actually, but as soon as they were shot the white feathers underneath were thrown up and they were then very conspicuous on these dark rocks. These were cases of protective coloration.

The caddis worm, the larva of the dragon fly, abundant in the waters of our parks, wraps itself in tubes made out of particles of sand; so that while it crawls around on the sandy bottom we cannot see it.

The crabs will do that, and not fasten the substances to their shells always, but will actually put them on. The common spider crab of our coasts has its outer covering rough and covered with peculiar hairy hooks and spines; and the animal will put seaweeds upon itself. If one found covered with green seaweed be placed in an aquarium with reddish brown seaweed, it will strip itself of the green and put on the brown, so as to harmonize itself with its surroundings.

Antennarius—a fish common in the Sargasso Sea—is in actual color brown, resembling gulfweed, and spotted, and has peculiar long tentacles or filaments running off from the body, which resemble the filaments peculiar to the gulfweed. It is one of the most beautiful cases of mimicry in color and form that we know of among fishes.

We find color mimicry even among snails; one species in Cuba affording a great variety of blues, reds, blacks and greens, more or less arboreal, living upon different colored fruits, as yellow or red bananas or pommes de terre—upon green fruits and green leaves. In all there is a thorny, hairylike substance on the outside of the shell which accumulates mud; so that the animal looks like a little ball of mud and is very inconspicuous when first detected.

As a rule, arboreal snails are green. The green ones among the Philippine Islands are arboreal right straight through, and resemble the foliage upon which they live.

Some snails, not being protected in other ways, have another curious form of protection, namely, teeth in the mouth of the shells. Mr. Pilsbry, of the academy, has concluded that these teeth are for the purpose of keeping out carnivorous enemies.

There are snails actually resembling thorns. This variety remained for a long time undiscovered until someone, carefully examining some of the bushes, noticed the fellows walking around upon the branches.

Animals, again, will have some part of the body that they can well spare brilliantly colored for the attraction of some enemy; this part, when grasped, being readily detached from the body, and, while losing the part, the sufferer escapes with its life.

A certain snail has upon the end of its tail a bright red spot, which comes off almost on touching it. A bird seeing this will seize the only object it sees, because the animal will be on a green leaf; the snail will part with this brilliant piece of coloring and drop to the ground and thus save its life. One authority in taking a large number of these snails found ten per cent. had lost their tails in this way to their enemies.

Lizards likewise lose their tails to their enemies and thus save their alter ego.

The squirrel has a very conspicuous tail. The Germans have dubbed the animal Eichhoernchen, "the little horn on the oak tree." A squirrel on the run has its tail spread out behind it. An enemy seizing this will get nothing but a bunch of hair, the skin at the tip of the tail coming off very easily with its tuft of hair, leaving the main brush still in the possession of the animal.

Another peculiar coloration among animals but recently pointed out by Wallace is the so-called warning colors. New examples are coming to light almost daily. One of the most conspicuous examples is the skunk, Mephitis Americana, than which probably there is no other animal on the American continent more conspicuous, and none to which we would more readily yield a clear coast. A peculiar secretion that can be voided by this animal is intensely offensive, but as long as the animal is left alone this is not put into operation. The animal is very conspicuous in the dark; and with its jet black underneath portion and its bright bands of white, it carries a signal flag to keep out of the way.

The tree toads, living on leaves, are green in color; while those living upon the ground are dull, like the clay and dirt of their habitat. In the tropics, tree frogs and ground frogs are nocturnal, almost without exception, and all of them have protective coloration.

There is a little diurnal frog, that leaps about perfectly fearlessly through the tropical woods, with brilliant blue coat and crimson breeches; and he is there in large numbers. His devourers are lizards and birds. A naturalist brought some home to his garden, and tried to feed them to his ducks, which would not have anything to do with them. Some pieces of meat, the size of these frogs, were fed by hand to the ducks, and, during the operation, a frog was substituted for the meat, and the exotic frog thus introduced into the mouth of the duck, which ran around the yard shaking his head as though he had received some very disagreeable acrid dose from the animal.

Some of the snails are extremely conspicuous on certain rocks. Voyagers down the Riviera have noticed a pure white snail attached to the rocks. A snail collector in Central America, having to use both hands in climbing the rocks whereon rested a conspicuously colored group of snails, seized the snails in his mouth, but could not keep them there. They were so very bitter and caustic he was obliged to throw them out. Most snails can be retained in the mouth without disagreeable consequences; but these snails upon the rocks undoubtedly protect themselves against their enemies, the birds, by a flavor they cannot stomach.

Since the creation there has been ceaseless activity among the carnivores and herbivores—among the former, to eat the latter; among the latter, to get out of the way. We have developed in the carnivores craft and strength; in the herbivores speed, as in the zebra.

There is nothing in the world more conspicuous than a zebra. And yet Baldwin, one of the most trustworthy naturalists, says that in his travels in Africa, on bright, starlight nights, the zebras would come so near that he could hear them breathing and yet could not see them. If the zebra's bands were any broader, it would appear as a black mass; and if any lighter, as a light mass. As it was, so did they harmonize with their surroundings it was impossible to locate them.

Cummings, in his travels in Africa, speaks of the giraffe, an animal almost as conspicuous as the zebra. Giraffes seen in the zoological gardens, back of grates, with ugly bars around them, stand out very conspicuously; but a herd of giraffes in the forest, with the light passing through in different ways, the sun spots here and there and the tall necks of the giraffes, it is impossible to see them; and Cummings says time and time again he has had a herd of giraffe browsing in the edge of a forest pointed out to him by his native hunters, and even with the aid of a telescope he could not see them himself. At yet other times he has taken the blasted tree trunks for the necks and bodies of giraffes; but found his mistake on closer approach.

The Bengal tiger, seeking its prey among the jungles, exactly harmonizes, in its upright bands of color, with the lights and shadows around it.

The leopard in the forest, resting upon the trunks and limbs of trees, with the play of lights and shadows from above, has in his own skin a very good imitation of the sun spots.

* Condensed from a lecture by Dr. Benjamin Sharp, at the Academy of Natural Sciences, Philadelphia.

Wild hogs are striped, and when threatened will squat among the leaves and become very inconspicuous.

The tawny color of the lion harmonizes with the barren wastes upon which it lives.

The bird known as the creeper, native among us, greatly resembles in color the bark of the trees.

The color of killdeers, both young birds and nests, closely resembles that of the stony ground on which they live.

The rabbit is very inconspicuous upon the ground at rest until he starts up and shows his white "cotton tail;" and this brings us to the recognition marks distributed among the gregarious animals, and to which Wallace has called the attention of naturalists.

Very characteristic recognition marks among the animals are those that are of such a nature as to keep the herd together. The peculiar white patch about the tail of a deer is one of these recognition marks. Hunters know that this can scarcely be seen if the animal is not frightened; but when, being shot at, it runs away, this is one of the most conspicuous features of the deer. The other members of the herd, seeing this recognition mark in the escaping animal, know the danger and take flight.

There is a peculiar white and very characteristic marking about the eye of one of the gazelles; and all these animals living in Africa and on our Western plains have more or less of these so-called recognition marks. The Rocky Mountain antelope has the recognition markings in the head.

We find birds also very well marked; for example, the white bands on the tail of the whippoorwill, which bands are not seen when the animal is not frightened or moving.

Mimicry was the first term used in these peculiar adaptations of color to surroundings. Originally the term mimicry meant a resemblance of the animal to its surroundings, be they animate or inanimate; but now we restrict "mimicry" to where one animal mimics another animal. This is very clearly shown in the humming bird moths, which have been repeatedly shot by the naturalist Wallace in mistake for humming birds. The humming bird moth is one of the sphinxes, in which the tongue, instead of being rolled up, is kept out straight, resembling the bill of the humming bird; while at the end of the abdomen a number of hairs run out and resemble, to a certain extent, the bird. The flight of the sphinx closely resembles that of the humming bird; and for two such naturalists as Bates and Wallace to be continually making these mistakes proves the resemblance and shows why a bird, feeding upon insects, would let a humming bird moth go, deeming it a humming bird.

In the East Indies, a cuckoo mimics a hawk in both size and color, so that one is often mistaken for the other.

The coral snake occurs in our Southern States and in Trinidad, being poisonous. There is a snake that mimics the coral snake that is perfectly harmless. Some of the people insist that all of the coral snakes are poisonous; others, who have had experience with the form mimicking the coral snakes, say they are not.

As to the leaf butterfly, in old books we read how bushes in India have flying leaves. The leaves would come off and fly around. Wallace in his work says: "In the East Indian archipelago we would see these butterflies alight upon a bush and thoroughly disappear." They simply resembled in form and color the leaves of the bush upon which they rested.

Caterpillar and cocoon found in this locality will resemble the bark of the trees upon which they rest. Doctor Skinner, entomologist of the Academy of Natural Sciences, relates how once finding one of these caterpillars and having at hand nothing to collect or carry insects, he went off a short time to get his materials, and on returning for this caterpillar, though he searched over an hour and though it probably had not moved over a half inch, it was so exactly like the bark of the tree he could not find it.

Not only does the caterpillar have this protective coloration, but also the cocoon, resembling the bark of the tree upon which it is spun. The butterfly, also, to a certain extent, is concealed in this way.

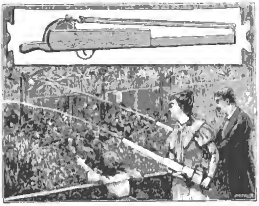
CONFETTI AND SERPENTINES.

DURING the Parisian carnival and midlent, confetti and serpentines have full sway. Although the invention is of recent date, it is making up for lost time. How many confetti and how many serpentines? According to the taste of some, there are altogether too many. Upon the boulevards and the large streets they form a continuous rain. In the evening, the confetti are found in layers of from half an inch to an inch and a half in thickness at certain points, and the serpentines are seen involving the trees in their multicolored meshes. In the sun the effect is charming, but the next day, if it happens to rain, the aspect is mournful.

The confetti having come into fashion, it follows as a necessary consequence that an endeavor has been made to derive as much advantage from them as possible. The spirit of invention is not wanting in Paris. People, getting tired of throwing them by the handful from the balconies of houses, have often, in order to expedite matters, emptied whole bagfuls of them upon the heads of the crowd. It is a very heavy circumscribed rain, but it does not last long enough. On the Boulevard de la Madeleine we have seen a dozen large bagfuls exhausted in this way in five minutes. This being wasteful, an endeavor was made to do better. Then the confetti cane made its appearance. This new air gun was a success, because the little disks are thrown to a distance and fall in a colored shower upon the floats and emblematic figures. It is impossible to escape the shot, for the weapon is accurate, and the projectiles, shot with force, fall gracefully upon the object selected as a target. At a distance of thirty feet one is as sure of covering his chance enemy as if he had fired an explosive shell. For the fetes of Nice and Cannes we shall evidently have some day a flower air gun, so that it will be possible to throw bouquets and perfumed petals to a distance. In the meanwhile, Parisians are firing confetti with the cane in fashion. This has the appearance of an ordinary bamboo walking stick. The silver head is unscrewed and the owner takes from his pocket a long cartridge loaded with a respectable number of colored confetti, which he introduces into the cane. With a rod he then rams home the cartridge, which causes a spring to bend. After this he tears and removes the paper covering. The weapon is now loaded. Toward the middle of the cane there is a trigger button. The "Queen of Queens" is passing. The button is pressed, the spring is freed and the entire supply of confetti is fired at once like a ball. A wheat sheaf jet forms at a distance of from 25 to 30 feet and descends like a colored rain upon the royal float, which becomes covered with emeralds and sapphires! There are persons who fire a hundred cartridges a day in this manner, much to the amusement of idlers. The confetti cane has proved a success.

In another form the same system has found its way into restaurants, to the family table, and especially into private rooms. A party has dined well and every one is merry; it is time for the champagne. The glasses await the bottle with its golden neck. The wire is cut, the cork starts and the foam is about to appear, when, to the surprise of all, a bouquet of confetti, instead, escapes with noise from the bottle, strikes the ceiling, falls back upon the table and covers it with petals of every hue. This is "champagne aux confetti." The stratagem may be imagined. As with the cane, the bottle has been loaded with a cartridge, and, through pressure upon a well concealed spring, the cork and confetti have been started.

Finally, in order to exhaust the list of novelties in this line, it would be unjust not to mention the "Spirobolus," a sort of serpentine shooting crossbow. This is an out of door apparatus that has its devotees. The serpentines thrown by hand do not go very far, and, in most cases, fail to hit the mark. The idea occurred to make the firing sure and to give it true precision. As if by magic, the spirobolus unwinds the roll of paper to its full extent in the twinkling of an eye. The effect of the unwinding of this colored paper band is very pretty. The system is simple. The roll is placed in a groove formed in the stock of the instrument, which is provided with a strong rubber cord that engages with a powerful spring. Upon a trigger being pulled the cord is freed, and the spring, in relaxing, sets the roll in motion. To this effect the roll is provided externally with a band of cloth which is attached to a fixed point, and which enters small points placed in the groove of the instrument. One of the ends of the serpentine is thus attached. The propulsion causes the unwinding of the roll, which continues paying out the paper until the other extremity is reached. It is unnecessary to say that firing with the spirobolus must not be done at close range, since some one might be hit and harmed by the roll before it was entirely unwound. —*La Nature.*



SPIROBOLUS FOR FIRING SERPENTINES.

CANE FOR FIRING CONFETTI.
1. Cartridge. 2. Ramrod.

CONFETTI FIRED FROM A CHAMPAGNE BOTTLE.

THE CULTIVATION OF CHICLE, FOR CHEWING GUM, IN MEXICO.

CHICLE chewing gum is principally extracted from the chico-zapote, the chic-zapotl of the Tarascans, says the Journal of the Society of Arts. Other plants are also chicle producing, such as Amate, growing wild in the district of Jalapa, Tabasco; Caimito, cultivated and found wild in the district of Jalapa, in the municipalities of Cunduacan and Cardenas, Tabasco, and in the canton of Jalapa, Vera Cruz; Cajon de mico, found wild in the municipality of Macuspana, Tabasco, and in the department of Comitan, Chiapas; Copo, found wild in the municipality of Frontera, Tabasco; Chichivisha and Matapalo, found wild in the municipality of Zanatepec, Oaxaca; and Sletilio or Yoyote, indigenous to the districts of Cunduacan, Yacajuca, and Huimanguillo, Tabasco.

Sir Henry Dering, H. M. Minister at Mexico, in a further report upon the vegetable products of Mexico, says that chico-zapote (Achras sapota of Linnæus) is the most abundant and important of the gum producing trees. This tree is found in many districts, and it is cultivated in the districts of Chonpam, Cincatlan, and in the municipality of Zanatepec, Oaxaca; in the districts of San Juan Bautista, Jalapa, Cunduacan, Cardenas, Nacayuca, and Huimanguillo, Tabasco; in the districts of Jalapa Cordoba, Minatitlan, Vera Cruz, and in parts of Morelos and Michoacan.

Chico-zapote belongs to the family of Sapotaceæ, and two kinds, the red and white, have been found in the dense forests of the above mentioned regions. The white zapote produces more gum than the red kind—as high as 6 pounds to the tree—and the white is generally taller, being 12 meters in height, while the red zapote has a thicker bark, from 8 to 10 meters high and seldom yields more than 3 to 4 pounds of chicle. The leaves of both trees are somewhat elliptical, and on young branches or shoots they are rather numerous. The fruit is spherical, sometimes 2 and 3 inches long; its edible matter is white, and tastes like the pear, and the seeds are two or three in number, of a dark brown color, flat, and irregular in shape.

A warm, moist climate is necessary for the successful growth of the tree if large amounts of fluid are expected. Higher than latitude 22° N. it will not grow at all, and north of Vera Cruz city it will not do well in the mountains above 2,000 feet. However south of 19° N. latitude it is cultivated at altitudes as high as 3,500 and 4,000 feet above sea level, yet it will thrive best at elevations between 150 and 1,200 feet even in these latter regions.

The best soil adapted for its cultivation is that occurring in valleys and undulating lands along the river meadows at the foot of the mountains. In the Tuxpam and Papantla valleys, especially in the dales adjoining the Pantapec, Cazones (San Marcos), and Tecolutla Rivers, splendid lands suitable for its cultivation can be found.

The zapote can be propagated from cuttings, suckers and layering, but the tree grows readily from the seed and that system has been adopted by those who plant it. Nursery beds are prepared in the usual manner in a half shaded space close to a stream. The seeds are sown in October and November, and sometimes in July. When the seedlings are 18 to 24 inches high, they must be transplanted.

As the tree is a hardy one, the expenses of keeping the zapote plantation clean are small. One or two light weedings a year is all that is necessary. At the fourth or fifth year after transplanting the tree may be tapped, but it is best to wait until the sixth or seventh year, or when they are 12 to 15 inches in diameter, wherein better results may be obtained. The tree lasts over 100 years, and then, or before, its fine wood can be utilized for the manufacture of first class furniture, or for durable timber. The gum is produced from the leaves, fruit, and bark of the tree. From the fruit it is extracted in the months of March and April, before the fruit becomes ripe. When gathering the fruit, the stem is allowed to remain on it, but subsequently taken off to admit of the juice running out. This is collected in a shallow vessel, allowed to solidify, washed in warm water to collect and clean it, and then boiled down to evaporate the water, set aside to cool, and lastly formed into blocks to be marketed. Three thousand two hundred zapote pears produce one pound of gum.

The fruit is also sold for about a cent apiece in Vera Cruz, Puebla, Oaxaca, Orizaba, Mexico, Guadalajara, and other large cities, and has recently been exported to the United States. In September and October the gum is extracted from the leaves. The process is the

same as that of the fruit, and the yield alike. After the rainy season is over, generally in October, the trees are tapped once every year.

The custom of the natives, the chicleros, is to get up the tree, to a distance of about 40 feet, make three diagonal cuts by a double oblique blow of the machete on either side of the tree, and have the wounds join at their lower ends. A shallow tin vessel is tied on to the tree below the wounds to collect the juice. Then the operator leaves this tree and taps another. He performs this operation in twenty minutes, and it takes three-quarters of an hour for the tree to bleed itself. One man will tap from twelve to sixteen trees per day, each producing from 3 to 6 pounds of juice. This is collected in gourds holding 12 pints, and heated in an iron pot until it boils up, when it is stirred with a stick quickly and continually until the foaming gum subsides, and has been reduced to half. When cool it is washed in water and formed into blocks, marquetas, of 2, 4, 6 and 12½ pounds.

Sir H. Dering says that the present system of tapping could be improved, and that the juice should be strained before being boiled down. The expense of a plantation of 100 acres to the time of production (six years after transplanting) is as follows: Clearing the land, from $600 to $800; nursery, $250; planting, $600; weeding six years, $1,200, and fencing, $50. At an additional expense of 10 per cent. a patch of Indian corn can be raised, and the proceeds from it will more than meet the expense of the plantation.

In the Tuxpam valley it costs from $5 to $7 per arroba of 25 pounds to gather and clear the gum—that is, by contracting the work with the experts (the chicleros); but by hired labor there and in Papantla, Misantla, Esperiol and Zamovra Gutierrez the cost will only be from 10 cents to 15 cents per pound. In Campeche and Michoacan the cost is as high as 20 cents per pound and in parts of Oaxaca, Vera Cruz, and Tabasco, from 4 to 25 cents a year per tree is paid for the privilege of tapping trees on private lands. The production of chicle for the year 1892, the latest for which the particulars are available, was as follows: In the district of Carmen, Campeche, 1,380,740 kilogrammes, valued at $12,000; in Oaxaca the districts of Juquila and Tuxtepec reported 1,150 kilogrammes each, valued at $950; in Puebla, the district of Huauchinango produced 1,300 kilogrammes, valued at $600; in Tabasco, the district of Balancan yielded 16,108 kilogrammes, valued at $11,200; and the municipalities of Zamora, Gutierrez and Tecolutla, Vera Cruz, reported 3,445,434 kilogrammes, valued at $1,824,000. Sir Henry Dering says that the price of chicle gum at New York City was, at the date of his report (July 18 last), 45 cents gold per pound.

THE POPULATION OF RUSSIA.

THE results of the first one-day census, which was made throughout the width and breadth of the Russian empire on February 9 last, were expected with great interest, says Nature. The last census was made in 1851, and a partial one in 1858, and yet it was not a census proper, for the local police authorities on the spot merely made lists of the permanent residents and taxpayers in each locality. After much preparatory work, it was decided to make, this year, a "one-day census:" that is, in the lists which had to be made for each house in each locality, all those persons who spent the night in a given house and in a given locality on February 9 (or about that date in the villages), had to be mentioned, whether they were permanent residents or not. It was quite a novel experiment, which was looked at with little confidence; but the vice-president of the Russian Geographical Society, who had had already a great deal of experience with such censuses as they were made, since 1870, in separate big towns (in these censuses the illiterate population filled their lists, as a rule, admirably well), insisted upon the new method being accepted. The census was organized under his guidance, and seems, so far as can be judged, to have been quite successful. The items, obtained from all the local committees, partly by telegraph—with the exception of some parts of the province of Yakutsk—are now published; and the population of the empire appears from them as follows: European Russia, 94,188,750; Kingdom of Poland, 9,442,590; Grand Duchy of Finland (Finnish yearly census), 2,527,801; Caucasia, 9,723,553; Siberia and Sakhalin, 5,731,732; the Kirghiz Steppes, 3,415,174; Turkestan, with the Transcaspian region and the Pamirs, 4,175,101; Russian subjects in Bokhara and Khiva, 6,412; total, 129,211,113. The corresponding figures, in 1851, were: European Russia, 52,797,083; Poland, 4,852,055; Finland, 1,636,915; Caucasia, 4,436,152; Siberia, 2,487,184; Steppes, 1,239,654; total, 67,380,645. It may thus be said that, although the percentage of births is very high in Russia, it took nearly fifty years for the population to double.

An English writer about Russia made, some time ago, the remark that Russia suffers from apolism, that is, from a want of towns. This want has lately very much disappeared. There are now in the empire no less than 19 towns having a population of more than 100,000 (out of which two in Poland, two in Caucasia, and one, Tashkend, in Turkestan); 35 towns with populations from 50,000 to 100,000, and 69 towns with populations of from 25,000 to 50,000. St. Petersburg has already attained the figure of 1,267,023, and Moscow approaches the million (988,610).

It is worth mentioning that no less than 200,000 persons took part in the census; very many of them were volunteers, who were recruited among the students of the universities and the high schools.

A Roentgen society has been formed, with Prof. S. P. Thompson as the president, says Nature. The intention of the founders is that the society shall occupy a position between those devoted purely to medicine, to physics, or to photography. Some of the members will study the sources of the Roentgen rays, others the applications; some the induction coils, others the tubes and the various forms and adaptations of the apparatus used in the production of the rays. Roentgen photography has been found serviceable in so many branches of scientific investigation that the society appeals to a large constituency for support. It should be the means of increasing the efficiency and applications of the rays, and should also be of assistance to surgeons and others who have entered the new field of work without previous training in physics.

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VICTORIA'S JUBILEE.

THE so-called "Diamond Jubilee" of Queen Victoria, which commemorated the sixtieth anniversary of her accession to the throne of Great Britain, was certainly the most splendid spectacle of modern times and was the most imposing outward display of the political, social and military factors of modern civilization which the world has witnessed. It was not only a personal tribute to the aged Queen who has reigned so well, but it was a manifestation of the imperial power of this great nation. To those who believe in the great destiny of the English speaking race that already dominates so large a part of the world, this demonstration has more than national importance and is vastly sig-

THE QUEEN'S JUBILEE—ILLUMINATION OF WINDSOR CASTLE ON JUNE 18.

nificant. Victoria's reign has been concurrent with the era of greatest expansion of the English speaking race. When the long reign is carefully analyzed, it will be seen that Thiers' famous saying, "The King reigns but does not govern," is not entirely applicable in this case. Victoria has been many times instrumental in shaping policies which have redounded to the credit of England and she has steered clear of the many blunders to which monarchs are so prone. Victoria's wisdom leads her not to seek to govern so much as to guide, and her gracious presence has often moderated the asperities of party conflict. Certainly no other ruler has done so much to make a proletarian outbreak like that of the French Revolution impossible.

The celebration of the "Diamond Jubilee" began on Sunday, June 20, with the holding of thanksgiving services throughout the kingdom, and everywhere, from a huge fair. The city was magnificently dressed with flags, bunting, and other elaborate decorations, and even in the smoke soiled back streets off the line of the route could be seen little union jacks sticking out of the top corner of a broken window of some cheap tenement. The whole city had to be seen before the meaning of the Jubilee could be appreciated in the gross.

Every available nook and corner was taken up with seats for spectators. They brought fabulous prices. In some cases the sum received was sufficient to entirely rebuild the structure. These stands were built with true British solidity, so that there were no accidents whatever. Just before the Jubilee prices for seats dropped to a wonderful extent, and many of the speculators found they were ruined. One gentleman, who some weeks before had paid \$5,000 for a room with two windows, found that they would not fetch over \$500. Bridge Road, Westminster Bridge, Parliament Street and the Mall to Buckingham Palace. First came the Royal Horse Guards, then the colonial troops. The troops consisted of Canadian Hussars, Dragoons, and Mounted Police, New South Wales Lancers and Mounted Rifles, with their graceful felt hats and brown boots, Victorian Mounted Rifles, New Zealand Mounted Troops, Queensland Mounted Rifles, Cape Mounted Rifles, South Australian Lancers and Mounted Rifles, Natal Mounted Troops, Natal Carabiniers, Umvoti, Natal and Border Mounted Rifles, Mounted Troops of Crown Colonies, Zaptiehs from Cyprus, Trinidad Mounted Rifles, and a few Rhodesian Horse. The colonial troops were very interesting and were well received, and gave an excellent idea of England's imperial possessions; then came various portions of the Naval Brigade and the high officers of the army. The

THE QUEEN'S JUBILEE—GROUP OF ENGLISH SOLDIERS AND NATIVE COLONIAL DETACHMENTS, INCLUDING POLICE OF BORNEO, POLICE FROM CYPRUS, AND HAOUSSAS FROM THE AFRICAN GOLD COAST.

St. Paul's Cathedral to the humblest village chapel, the people met to pray for Her Majesty. A private service was held in St. George's Chapel, Windsor Castle, which was attended by the Queen and the members of the royal family. Her children embraced her after the service. Public service was held in the chapel in the afternoon, a chorus of five hundred voices giving Mendelssohn's "Hymn of Praise." A special service was held in St. Paul's Cathedral, London, in which the diplomats, special Jubilee envoys and judges in their robes of state attended.

Continuous services were held in many of the churches throughout the day. It was the strangest Sunday ever seen in London. London is ordinarily the most dreary place imaginable upon the Sabbath; so much so that Americans, at least, are always glad to get away from its depressing influence; but on this occasion the route that was to be traversed by the royal procession resembled Desirable seats cost from \$25 to \$150 and even more, and everything else was in proportion. The commercial aspect of the Jubilee is, perhaps, the only disagreeable feature connected with it, and it was very hard to see how it could have been avoided.

The Queen made a triumphal progress from Windsor to London, where she rested at Buckingham Palace. In the early morning of Tuesday, June 22, the great day of the royal procession dawned cloudy and still, but very shortly before the Queen's carriage became visible, in the courtyard of Buckingham Palace, the dark clouds were thinner and less ominous. The rest of the morning and afternoon was bright and sunshiny. In brief, the route of the procession was from Buckingham Palace, around Constitution Hill, down Piccadilly, St. James Street, Pall Mall, the Strand, Fleet Street to St. Paul's, then by way of Cheapside, London Bridge, Borough High Street, Borough Road, Westminster total number of troops employed in the procession as guards of honor and in lining the streets was 46,943.

Punctually at eleven the starting gun in Hyde Park was fired as a signal that the Queen had entered her carriage. Her progress toward St. Paul's Cathedral, where the colonial procession had already gone, was made with few delays. Various detachments of soldiers and representatives of the navy led the way. After the regular troops had passed came the naval and military aides-de-camp to the Queen. Then the pageant became more gorgeous than ever, the foreign naval and military attachés glittering in their many colored uniforms; ambassadors came next, and now the excitement was most intense as the Queen and her escorts appeared. Perhaps there was never assembled in public a more august body of dignitaries. There was an escort of thirty-six English and foreign princes on horseback, riding in threes; an Indian escort of twenty navy offi-

cers and cavalry regiments followed; then came the supreme moment for which the many millions had been waiting. Field Marshal Lord Wolseley, Commander-in-Chief of the British army, rode by alone, and then there were seen the cream colored horses which were famous throughout the empire drawing the carriage in which sat the sovereign. The enthusiasm knew no bounds. It could, perhaps, be described adequately by saying it was an avalanche of sound. It was difficult to believe that seventy-eight eventful years had passed over the Queen's head. Her Majesty was seated opposite the Princess of Wales and the Princess Christian. The Prince of Wales, the Duke of Connaught and the Duke of Cambridge were by her side as outriders; behind followed the royal standard, grooms and equerries. Last of all come the Royal Irish Constabulary and a squadron of the Horse Guards. When the Queen's carriage reached Temple Bar the Lord Mayor was waiting to receive Her Majesty to render official homage and to present a pearl sword of state. She spoke a few words in reply to the address of the Lord Mayor and the procession moved on to St. Paul's.

As the Queen approached St. Paul's Cathedral the Archbishops of Canterbury and York, with a numerous train of clericals, emerged from the west front and stood upon the steps, where they awaited the arrival of Her Majesty. Immediately, as the Queen's carriage was drawn up, the choir intoned the "Te Deum," after which the Bishop of London offered a prayer. The Archbishop of Canterbury then pronounced the benediction, after which the choir sang the Hundredth Psalm. This service is an interesting contrast to that which occurred when the girlish Queen had been anointed in Westminster Abbey, sixty years before. The ceremonies at St. Paul's were so interesting that we cannot refrain from giving Mr. G. W. Steevens' pen picture of the event which he gave in the Daily Mail.

"Riding three-and-three came a kaleidoscope of dazzling horsemen, equerries, aides-de-camp, attachés, ambassadors, and princes, all the pomp of all the nations of the earth—scarlet and gold, azure and gold, purple and gold, emerald and gold, white and gold—always a changing tumult of colors that seemed to list and gleam with a light of their own. It was enough. No eye could bear more gorgeousness; no more gorgeousness could there be, unless princes are to clothe themselves in rainbows and the very sun.

"The prelude was played, and now the great moment was at hand. Already carriages were rolling up, full of the Queen's kindred, full of her children and children's children; but we hardly looked at them. Down there through an avenue of eager faces, through a storm of white, waving handkerchiefs, through roaring volleys of cheers, there was approaching a carriage drawn by eight cream colored horses. The roar surged up the street, keeping pace with the eight horses. The carriage passed the barrier; it entered the churchyard; it wheeled left and then right; it drove up to the very steps of the cathedral.

"We all leaped up. Cheers broke into screams, and the enthusiasm swelled to delirium. The sun, watery until now, shone out suddenly, clear and dry, and there and there and there was a little, plain, flushed old lady, all in black, with a silver streak under her black bonnet, and with a simple white sunshade, sitting quite still, with the corners of her mouth drawn tight, as if she was trying not to cry. But that old lady was the Queen, and you knew it. You did not want to look at the glittering uniforms now, nor yet at the bright gowns and young faces in the carriages, nor yet at the stately princes, though by now all these were ranged in a half circle round her.

"You could not look at anybody but the Queen, so very quiet, so very grave, so very punctual, and so unmistakably every inch a lady and a Queen.

"It was almost pathetic, if you will, that small, black figure in the middle of these shining cavaliers, this great army, this roaring multitude, but it was also very glorious.

"When other kings of the world drive abroad, an escort rides close at the wheels of their carriages. The Queen drove through her people quite plain and open, with just one soldier at the curbstone between her and them. Why not? They are quite free. They have no cause to fear her. They have much cause to love her. Was it not all for her—gala trappings of the streets, men, horses, guns, and the living walls of British men and women? For the Queen summed up all that had gone before—all the soldiers and sailors, the big limbed colonials, and the strange men from unheard of islands over sea.

"We know now what that which had come before all stood for. We knew as we had never known before what the Queen stands for. The empire had come together to revere and bless the mother of the empire. The mother of the empire had come to do homage to the one being more majestic than she.

"There were the archbishops, bishops and deans in gold and crimson caps and white, orange and gold embroidered vestments waiting on the steps. There, through gaps in the pillars and scaffoldings, you could see all her ministers and great men, a strange glimpse of miniature faces as in some carefully labored picture, where each face stands for an honored name.

"All stood, and the choir sang the 'Te Deum.' Next rose up a melodious voice intoning prayers. The Queen bowed her head and then the whole choir and the company outside the cathedral and the whole company in the stands, at the windows, on the housetops, and away down the street, all standing, all uncovered, began to sing the Old Hundredth Psalm, 'Come ye before Him and rejoice.'

"The Queen's lips were tight, and her eyes, perhaps it was fancy, looked dim; but then 'Three cheers for the Queen!' and the dean, pious man, was wildly waving that wonderful crimson cap, and the pillars and roofs were ringing as if they must come down. Then 'God Save the Queen,' a lusty peal till you felt drowned in sound.

"The Queen looked up and smiled, and the Queen's smile was the end and crown of it all, a smile that broke down the sad mouth, a smile that seemed half reluctant, so wistful, yet so kind, so sincere, so motherly."

The colonials fell in behind the royal procession after leaving St. Paul's. A brief stoppage was made at the Mansion House by the Lord Mayor's wife, who presented a bouquet to the Queen, and here Her Majesty dispensed with the attendance of the Lord Mayor, who had accompanied her from Temple Bar. The procession then continued to London Bridge, and thence along the streets on the southern side of the Thames. It reached Buckingham Palace at 1:40 P. M., twenty minutes before the programme time. Before the return of Her Majesty to the palace, she lay down for an hour, and spent the rest of the afternoon in the garden. She bore the fatigue exceedingly well. The enthusiasm of the British people for several days was unbounded, and the splendid display of sea power—the greatest the world ever saw—on June 26, at Spithead, was the other crowning feature of this memorable occasion.

Our engravings, for which we are indebted to L'Illustration, represent the military tattoo at Windsor before the departure of the Queen, and the colonial soldiers in the procession, and the procession passing through Whitechapel.

THE QUEEN'S JUBILEE—COLONIAL TROOP PASSING THROUGH WHITECHAPEL.

INCREASE OF THE DRYING POWER OF OILS.

By A. LIVACHE.

THE principal factors which increase the power of fixing oxygen of a siccative oil such as linseed are, first, the degree of purity of the oil; secondly, the time which has elapsed since its extraction; thirdly, the conditions under which it has been kept; fourthly, heat; fifthly, the addition of certain substances.

1. The Degree of Purity of the Oil.—When the oil has been extracted by the press, it contains water and impurities, and it is evident that in order to have an elastic and even mass, it is an advantage to extract these substances. This is done either naturally, allowing the clarification to proceed by simple deposit, or by a direct treatment by means of filtration or a chemical. This last means, which generally consists of treating the oil with sulphuric acid, frees it from substances which do not play any part in its drying qualities, as they do not fix oxygen. As a matter of fact, in a comparative test by exposure to the air of a recently pressed oil and the same oil treated with sulphuric acid, then freed by washing from all trace of the acid, it is seen that in the second case the oil absorbs a greater quantity of oxygen. Moreover, it is evident that the final product will be the whiter, as the oil, to begin with, is less colored, which suggests the necessity of the bleaching operation.

2. Age of the Oil.—Oil preserved from the action of the air absorbs oxygen the better the older it is. It is thought that it is due to the formation of new compounds in the oil. Dr. Fahrion believes that the non-saturated fatty acids enter into combinations among themselves to form new and complex bodies.

3. Method of Preservation of the Oil.—Outside the question of age, if the oil has been kept in such conditions that it has been in contact with the air, it has already absorbed a certain quantity of oxygen. Experience shows that even if to begin with the oil only slowly absorbs oxygen, once this absorption has begun, it proceeds much more rapidly. In any given oil, therefore, the absorption of the oxygen will take place much more rapidly when it has been exposed to the air.

4. Action of Heat.—The temperature at which an oil is exposed to the air has influence upon its drying powers. Chevreul showed that linseed oil dried much more quickly at a temperature of from 25° to 28° C., than at a temperature of from 15° to 18° C. Moreover, if crude linseed oil and the same oil which has first been submitted to the action of the heat are exposed to the air under the same conditions of temperature, a difference in their drying powers will be found. If, for instance, linseed oil is heated for three hours, so that it only disengages a few gaseous bubbles from time to time, the oil becomes much more siccative, as Chevreul has shown. It takes about half as long a time to dry. Dr. Fahrion explains this by saying that, under such conditions, boiling in a deep vessel to which little of the oxygen of the air can gain access, the combination of the non-saturated fatty acids among themselves is accelerated, and complex products are formed capable of absorbing oxygen more rapidly.

Chevreul, in continuing to heat the linseed oil under the same conditions, proved, on the other hand, that the oil heated for five hours is at the end of this time less siccative than the oil heated for three hours only. It is probable that under the influence of this pro

longed heat a part of the glycerine is destroyed, as a certain acrid smell indicates, and the linoleic acid is set at liberty, and it is known that linoleic acid dries less quickly than linolein. It is probable for the same reason that Mulder has found that linseed oil heated only to from 70° to 100° C. dries less well than crude oil. We can sum up, therefore, as follows: First, that a moderate temperature assists the drying of the crude oil; secondly, that exposed to the same temperature the crude oil dries less quickly than if it had first been submitted to the action of heat, with this reserve, that the action of heat has been such that the oil has not commenced to decompose, with the result that a certain quantity of linoleic acid has been set at liberty.

5. The Addition of Certain Substances.—Long experience has shown that the addition of certain substances, such as white lead, litharge, oxide of manganese, etc., assists the drying of a siccative oil. In certain cases these substances are mixed directly with a cold oil, in other cases heat is used in making the mixture.

Let us first consider the plumbic compounds which have been employed for a long time as driers. The commonest process consists in heating the oil with these plumbic compounds, and the increase of drying power has been attributed sometimes to the formation of linoleate of lead, at the same time that linoleic acid is liberated by the heat, and sometimes to the oxidation produced by the oxygen of the oxide of lead, pointing out as a proof of this that at the end of the operation there is a deposit of a certain quantity of metallic lead.

This double explanation does not seem exact, for the following reasons: In the first place, experience teaches that linoleate of lead gives only factitious drying power, since the product quickly becomes brittle and friable. On the other hand, linoleic acid dries less quickly than linoxine. Nevertheless, it is indisputable that an oil heated with oxide of lead has a drying power greater than a crude oil, or oil cooked without the addition of the oxide. It may be asked, therefore, if it is not owing to the oxygen of the oxide of lead that the drying power is augmented. If it is remembered that a linseed oil of good quality, exposed to the air, absorbs 16 to 18 per cent. of its weight on turning into a solid and perfectly dry substance, and if, on the other hand, we reflect that in practice the quantity of oxide of lead used is not more than 3 to 8 per cent. of the oil, it will be seen that the oxygen that the oxide of lead could furnish is less than 1 per cent. of the weight of the oil, whereas from 16 to 18 per cent. are necessary, and that, therefore, it cannot play anything more than a secondary part from the point of view of direct oxidation, the more so that a part of this oxide of lead does not give up any of its oxygen, since it enters directly into combination to form a plumbic soap. Nevertheless, the presence of a certain quantity of metallic lead at the end of the operation proves that a corresponding quantity of oxygen has been at liberty to commence the oxidation of the oil, and, as we have seen in studying the effect of oxygen on crude oil, the drying proceeds more rapidly after the oxidation of the oil has reached a certain degree. In any case, this reaction seems to be a secondary one, in view of the notable increase of the drying power. The same objections and the same explanation might be made on the subject of the augmentation of the drying power by the use of manganic compounds.

However, a more acceptable explanation may be given, based upon a very important observation made by Chevreul, who showed that if linseed oil were spread on a sheet of lead entirely freed from all trace of oxide, the drying power of the oil notably increased. It is evident in this case that the oil cannot absorb any oxygen, except that which is furnished normally by the air. The augmentation of the drying power is due really to nothing else than the presence of the metal. This experiment may be carried further. If a crude siccative oil is shaken up in a bottle, with very porous lead, obtained by the precipitation of a salt of lead by another metal, it will be seen that without the necessity of any elevation of temperature the siccative oil has a much greater drying power than before this treatment, and in this case it is certain that the oil has not been furnished with any oxygen. The only certain modification is that after the treatment with precipitated lead the oil contains a small quantity of the metal, and we are led to conclude that the augmentation of the drying power is due uniquely to the presence of this small quantity of lead.

The same experiment cannot be made directly with the manganic compounds, but indirectly the oil can be placed in the same conditions with regard to manganese. To do this it is merely necessary to stir up the oil treated with the precipitated lead with a salt of manganese, the sulphate, for instance, which by double decomposition gives a salt of lead insoluble in oil and at the same time manganese as a substitute for the lead. Following out this experiment, it is shown that the oil thus "manganesated" has a very great drying power, superior even to that obtained by heating crude oil with a manganic compound. It is by experimenting upon this manganesated oil thus prepared that it is possible to find an explanation of the augmentation of the drying power. If this oil is spread in a thin coat in contact with the air, it is seen to take a brown tint, due to the oxide of manganese present passing to a superior degree of oxidation, by taking oxygen from the air. But as the oil becomes more viscous the brown tint is seen to disappear; finally this coloration disappears completely, the oxygen of the peroxide of manganese having served to oxidize the siccative oil, and finally a solid mass without color is obtained.

This brown coloration, followed by a complete loss of color, shows that the oxide of manganese has served as an intermediary, itself oxidizing easily by contact with the oxygen of the air, and then giving up this oxygen to the oil.

The action obtained with oxide of lead is very probably similar to this, but with a smaller degree of energy. In an oil to which litharge or manganese has been added, the lead and the manganese play a part of intermediaries, robbing the air of its oxygen to give it up in a continuous manner to the oil, which is thus oxidized more rapidly than it would be without these intermediaries.

It was natural to try if other metals were capable of playing the same part as lead and manganese. The simplest way of experimenting in this direction is to take an oil to which litharge has been added and stir it up with salts of the different metals, to find out which will give with the lead a salt insoluble in the oil. Operating thus, we have proved that if the oil prepared with litharge spread in a thin coat on a plate of glass dries in twenty-four hours, the oil in which the lead is substituted by manganese dries in six hours; by substituting copper, zinc, or cobalt for the lead, the oil takes from thirty to thirty-six hours to dry; and, finally, the oils obtained by substituting nickel, iron, chrome, etc., for the lead are not completely dry until forty-eight hours have elapsed. A very important point to note is that a manganesated oil got by substituting manganese for the lead of an oil prepared with litharge dries much more quickly than an oil manganesated directly.

In practice, in addition to the oxides of lead and of manganese, certain salts of these oxides are used, but their choice seems as if it should be subordinated to their degree of solubility in the oil and the manner in which they behave when heat is employed. In practice, moreover, of all the salts proposed, none other than the acetate of lead and the borate of manganese have been retained, and the explanation of this is easy. It is that these two salts submitted to the heat decompose and give finally either the oxide of lead and very finely divided lead or the oxide of manganese. To take the case of the acetate of lead, it is known that this salt melts in its water of crystallization at about 75° C.; at a temperature higher than 100° C. it loses water and a little acid, giving a sesqui basic acetate, which is completely decomposed at about 290° C. Carbonic acid and acetone are freed, and as a residue very finely divided lead is obtained, of which we have already seen the important role as a drier.

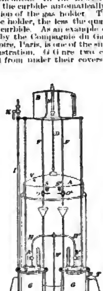
In the case of borate of manganese we have to deal with a very unstable salt, as most of the borates are. The affinity of the boric acid for the oxide of manganese being very weak, under the influence of heat the latter is set at liberty. The use of this salt is, therefore, simply an advantageous way of introducing the oxide of manganese.

As experience has shown that metallic lead in a very porous state augments the drying power of the oil, it was interesting to study the action on the oil of other metals easy to obtain by precipitation. In operating, however, with precipitated copper and tin, it was found that the drying power of the oil did not sensibly increase. This result was to be foreseen, for Chevreul had shown that linseed oil spread on a well cleaned sheet of lead dried much more rapidly than that spread on sheets of copper, brass, zinc or iron. With these metals the drying power was not much more rapid than if the oil had been spread on porcelain, glass, or plaster.—Vernis et Huiles Siccatives; from the Western Painter.

RECENT IMPROVEMENTS IN ACETYLENE GAS GENERATING APPARATUS.

The means for producing acetylene gas are constantly being improved in Paris. Low pressures alone are favorably considered. A very important industrial exhibition just closed in that city showed that inventors are not idle in devising apparatus for giving better results.

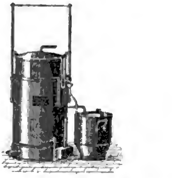
The superproduction of gas after the cessation of consumption has met with the most attention in recent appliances. This inconvenience was combated in Trouvé's generators some eighteen months since by glass rings dividing the carbide into parcels, and so, in some measure, preventing a too rapid attack upon the whole of the chemical. In the newest machines the water is fed to the carbide automatically by the movements of deflation of the gas holder. The higher the elevation of the holder, the less the quantity of water allowed to the carbide. As an example of this type of machine, that by the Compagnie du Gaz Nouveau, 64 Rue de la Victoire, Paris, is one of the simplest for the purpose of illustration. G G are two cast iron pots, readily slid out from under their covers for the pur-



pose of refilling. H H¹ H² connect the generators to the gas holder, A, to the top of which is attached a chain, D, acting upon a stop plug, N, within the water reservoir, B, so that the water therein is opened to or cut off from the two supply pipes, F F, feeding the carbide holders. The supply is commenced automatically by means of two spring catches, S S, attached to the sides of the gas holder, pressing back the lever cocks, O O¹. A little water poured in at one of the funnels starts the holder. K is the gas supply pipe from the gasometer. V is a safety valve, as a precaution against any hitch with the holder; and as the generator pots are closed by the cocks, R R¹, when the apparatus is not in use there would be a chance of these cocks being left shut through a forget when they should be open, so each pot is fitted with a water siphon, the seals of which would naturally be broken by any excess of gas in the generators.

Only one generator is used at a time under ordinary circumstances, and as soon as the charge in one is exhausted the other is started, so that the gas supply can be kept up indefinitely.

The smallest apparatus made contains about one pound of calcium carbide in each generator, or one kilogramme in all. This charge is good for ten hours



with three burners going, each burner using ten liters per hour. The price of the machine complete (and which is well made) is 140 francs. The size of the gas holder is 19½ by 19½.

Another apparatus, by V. Daix, 72 Rue Louis Blanc, Paris, has the same system for feed water supply, but, instead of using taps in his connecting pipes, this inventor uses water siphons throughout as being less liable to cause errors of working; and, still more important, he divides the carbide into a number of small lots, each of which is preserved from the action of water or vapor until the supply calls for its use. Superproduction of gas is thus reduced to a minimum, as will be readily understood. The inventor estimates that as much as thirty-five per cent. is lost by superproduction in apparatus in which the carbide is not subdivided and preserved from the action of vapor.—Photography.

FOOD TABLETS.

Not long ago an American chemist, evidently a disciple of Prof. Berthelot, of France, stated that the time was near at hand when hot water and food tablets would be the sole accouterments of a kitchen; that the essential food elements of a twelve hundred pound steer can be put into an ordinary pill box, and that a single concentrated soup tablet the size of a pea will make a large bowl of soup of full nourishing strength. A ration case weighing eight ounces was planned. It contained the following supply: Three tablets of concentrated soups, equal to three quarts; four beef tablets, equal to six pounds of the meat; one milk tablet, equal to one pint; two tablets wheaten grits, equal to two pounds; one tablet egg food, equal to twelve eggs.

Viewed from a chemical standpoint, it may seem possible to reduce, by condensation, the bulk of man's food almost indefinitely, and thus furnish in a thoroughly portable and convenient form nutriment for the body which will remain unchanged through long periods of time and in spite of the influence of varying conditions of temperature and climate; but from a physiological point of view may be seen serious obstacles to the successful consummation of such a proposition. That condensed and concentrated foods have a direct sphere of usefulness will not be denied, but that food tablets and similar products are well adapted to constitute the sole food of healthy men for any length of time is an undeniable fallacy. Combined with fresh foods they may yet prove of service; for, like the particles of yeast added to the dough, the necessary principle contained in the ordinary food may leaven the whole lump.

But practical experimental evidence is always most convincing and hence we append the following dispatch which recently appeared in a reliable periodical: "A dispatch from Denver was published stating that the troops at Fort Logan have made the first test of the new emergency ration. One company went out for three days of forced marching in the foothills of Denver, loaded with coffee tablets and compressed soup that was supposed to contain all the advantages of hard tack and coffee. On the night of September 11, the medical officer charged with weighing and watching the men rode into Morrison for assistance. He reported that thirty-six out of the fifty men are down with griping pains resulting from the non-assimilation of the scientific ration. The order could not be revoked, and the men in the field were informed that they would have to remain on the march for two days longer."—Dietetic and Hygienic Gazette.

A TRAVELING NURSERY

And now comes the traveling nursery to take its place alongside the barber shop, bathroom, etc., on our fast trains, says the Railway Review. The traveling nursery is to take up about the same amount of space as the private stateroom of the ordinary sleeping car. There will be a saving of a space of several feet, however, as the wide seats on the sides of the stateroom below the berths are not needed in the nursery, being replaced by ottomans and tiny easy chairs scattered over the floor. In this way any danger from sudden starts or sharp curves is obviated. As a further protection against injury to the little ones, the walls of the nursery are heavily padded and the floor thickly carpeted, so that bumps and bruises will be altogether avoided. At each end of the compartment, and firmly secured, are two cozy cots in which the smaller children may lie and watch the games of the older ones. Each car containing the nursery attachment will carry a matron or nurse, who will be selected with special re-

ference to her ability to amuse and care for her little charges; and she will have at hand supplies of milk, cookies and other edibles and drinkables dear to the infantile heart. She will also have charge of a medicine chest containing a full assortment of the simpler remedies for childish ailments. A miniature toy shop is another adjunct of the traveling nursery, and it will contain everything from baby rattles to picture books and fairy tales. Nothing, in short, will be missing that would add to the comfort or amusement of the young travelers. It is not intended that every sleeping or parlor car can be provided with the nursery attachment. Large as is the number of children passing, it would be necessary to have but one such car in every through train running between the larger cities. The expense of equipment, matron's wages, etc., would thus be kept down to a reasonable limit. Although child travelers are numerous now, and the sending of them alone from one city to another is increasing each year, railroad officials who have examined plans for the new compartment anticipate an increase in business through their adoption. It will not be long before the railroads will be able to advertise "all the comforts of a home," while en route.

NITROSYLIZED BLAST FURNACE SLAG AS AN ADDITION TO HYDRAULIC CEMENT.

WHEN a cement briquette is kept immersed in water for several months, it loses considerable of its lime, say from 5 to 10 per cent. This portion of the lime is in excess of combination, the cement composition being too basic to yield to it sufficient gelatinous silica to bind it. Hence, nearly all hydraulic cements can be improved by the judicious admixture of siliceous substances, that yield an additional supply of gelatinous silica. The volcanic earths, such as trass, santorin and puzzuolane, possess this property to a remarkable degree, but they are not much used for admixture on account of their comparatively high cost. A much cheaper and in some respects excellent substitute is found in blast furnace slag of singulo to sesqui-silicate constitution, high in alumina and lime, and finely pulverized. Dissolving lime reacts only superficially on such admixtures, but it extracts from them a little gelatinous silica, and the resulting compounds—minute particles of hydrosilicate—cement the mass more firmly.

Unfortunately, such slag contains from 1 per cent. to 3 per cent. of calcium sulphide, which is easily decomposed by water containing carbon dioxide. This sulphide obtains in the slag in intermolecular combination, which means that it is rather evenly distributed throughout the whole mass, and that even the smallest slag particles contain some of it. In dissolving—under the conditions in which it obtains in applied cement—it changes readily to calcium-sulphhydrate; the latter, being in aqueous solution, becomes mixed up with the gelatinous silica and with the dissolved lime, and the lime changes it back to sulphide. Thus the forming particles of hydrosilicate, which are to bind the mass more firmly, become tainted with unstable sulphur compounds, hence they are apt to disintegrate and to cause the cemented mass that contains them to weaken long after it has become indurated, sometimes after the lapse of years.

In order to illustrate the slag question more fully, it may be as well to sum up as follows: Crude slag that is sulphurous cements well at first, but is not a reliable constituent, and crude slag that is not sulphurous is usually so acid as to exert scarcely more chemical energy than ordinary sand does. There is, practically, no intermedium, for even the singulo-silicate slag from charcoal blast furnaces contains sufficient of CaS to be, in its crude state, objectionable for the purpose herein considered.

In order to free blast furnace slag from this objectionable feature, several methods have been proposed for desulphurizing such slag in its molten state; but they have not yet been tried, the chief obstacle being that blast furnace managers are very reluctant to try anything that is apt to interfere in the least with other routine work. Moreover, with Rosendale cement selling as low as 70 cents for a barrel of 300 pounds, and with Portland selling as low as $2 for a barrel of 380 pounds net, the cement producers are not over-anxious to adopt any new ingredient unless its use will cheapen the cost of their product considerably; and so the matter rests.

There is, however, a possibility that the recently invented process of nitrosylizing pulverized slag will prove to be of greater commercial interest to both classes of these industries than anything that has thus far been attempted with that much neglected by-product. The main reason for this assumption is, on the one hand, that the condition in which the slag is to be delivered from the dump and paid for can be brought about by the furnace men without causing them any appreciable inconvenience, and on the other, that the slag which is thus delivered can be adapted for cement at a smaller cost than that which would be involved by any other effective treatment that has thus far been proposed. The treatment itself is very simple and offers no new features of general interest; it is fully described in the patent specifications (United States patent, No. 579,890, March 30, 1897), which are rather too long to be reproduced in this paper. Suffice it to state that nitrosylized slag is prepared by moistening finely ground slag of suitable composition with a weak solution of nitric acid, by adding more water after the acid has become neutralized and by drying the leached mass. The complete treatment requires about one-half a pound of 60 per cent. acid (N_2O_5) and about 30 pounds of water for each 100 pounds of pulverized slag, and the product is cheap enough to be even sought after by the manufacturers of Rosendale cement.

The primary object of the treatment is, of course, to eradicate, as it were, the CaS that crops out on the surface of the slag particles. The total quantity that becomes thus eliminated is rather small, and when the acid is used in the above-mentioned proportion it amounts to less than 0·1 per cent. with slag that contains about 2 per cent. This superficial desulphurization is, nevertheless, very effective, for the pores that are produced by the elimination of the sulphide are apt to become closed up by the formation of hydrosilicates in the beginning of the cement reactions, and before any deeper reaction can set in, and thus any future deleterious action of the remaining sulphide is rendered impossible.

The secondary, but not less important, object of the treatment is to utilize the nitrosyl that is set free by the nitric acid while it reacts on the slag particles. In other words, slag of singulo to sesqui-silicate constitution, and high in alumina, contains constitutionally—or aside from purely accidental ferruginous matter—more or less of ferrous silicate, say from 1 to 3 per cent. It is well known that attenuated solutions of ferrous salts absorb nitrosyl with great avidity and under evolution of heat, the thermal effect ranging, according to various authorities, from + 9° to + 11° calories. The ferrous silicate of the slag absorbs it likewise; hence it is to be presumed that this absorption must render its silica more disposed to sever its connection with the ferrous oxide, and to become gelatinous, when reacted upon by dissolving lime. The accidental ferruginous matter of the slag also absorbs nitrosyl and is thereby prevented from readily changing on its surface to ferric hydrate. As the formation of ferric hydrate involves an appreciable enlargement of the volume of the particles thus affected, it stands to reason that such a change is not desirable in applied cement; and as one volume of nitrosyl gas requires twenty volumes of water for its solution, it is not likely that nitrosylized slag is apt to "rust" very quickly.

Coming now to the question of the actual efficiency of nitrosylized slag, the writer has arrived at the following conclusions:

1. High-class Portland cements, those that have been ground from carefully prepared stock that has been burned very hard, can only be improved by the admixture of small quantities, probably not exceeding 10 per cent. in the average.

2. Inferior Portland cements may be mixed with about their own weight of nitrosylized slag, and still give as good results as the neat. The following tests, recently made in the usual way, with briquettes of standard size, may serve as an illustration:

A.—TEST OF HIGH-CLASS PORTLAND CEMENT.

No.	Composition of Mixture.	Water added. Per cent.	Age. Days.	Tensile strength per square inch. Pounds.
1	Neat cement...........	[illegible]	19	[illegible]
2	" "	[illegible]	17	[illegible]
3	Cement: 90%, slag: 10%.....	[illegible]	18	[illegible]
4	" 60%; " 40%.....	[illegible]	19	[illegible]

B.—TESTS OF AN INFERIOR PORTLAND CEMENT.

No.	Composition of Mixture.	Water Per cent.	Age. Days.	Tensile strength Pounds.
1	Neat cement...........	22	18	310
2	Cement: [illegible]; slag: [illegible]......	17	19	[illegible]
3	" [illegible]; " [illegible]......	16	19	[illegible]

Briquettes made up of cement, nitrosylized slag and sand are apt to give rather poor comparative results as regards their test for tensile strength unless the sand is added after the cement and the slag have been thoroughly wet-mixed, for it is scarcely possible to dry-mix three different substances as well as two. A much fairer test would be to slurry the mixtures, just as is done in working cement for the "second set," and to fill the slurry into the moulds without beating it. The limit of tensile strength would then be barely as high as in testing by the usual method, but it would certainly be more in accord with the amount of resistance which the respective mixtures actually acquire in being applied to masonry.

A briquette, made by casting the mixture into the mould, and composed of

Cement "A" 90 per cent. and nitrosylized slag 10 per cent., the water added being 30 per cent., broke when 17 days old at 350 pounds tensile strain per square inch. This is a pretty fair result, considering that this mode of testing is apt to lower the limit of tensile strength of even the best cements 40 per cent. or thereabout.

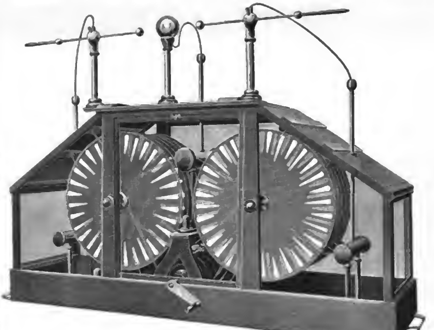
The above notes were published by Mr. A. D. Elbers in the Engineering and Mining Journal.

SOIREE OF THE ROYAL SOCIETY.

THE last Royal Society soiree took place at Burlington House in May. The place of honor in the council room was given to Mr. A. A. C. Swinton, whose researches into the nature and behavior of X rays are so well known.

Mr. Swinton's experiments dealt both with cathode rays and X rays. In relation to the former he showed that by replacing the usual screen of fluorescent material by one of ordinary electric light carbon, much appears which was previously invisible. When a concentrated stream of powerful cathode rays is focused on a surface of carbon, a brilliant luminescent spot appears on the carbon at the point of impact of the rays. The effect is entirely on the surface, and when the cathode stream is rapidly deflected by a magnet the luminescent spot moves with no perceptible lag. The tube in which these phenomena were shown was kept connected to the pump, because the vacuum is rapidly reduced by the hydrocarbons thrown off by the carbon.

In tubes of the ordinary focus type with a single spherical concave cathode the rays appear to converge in a cone to a focus, and if the vacuum be not too high, to diverge again in another cone upon the other side of the focus. At higher vacua the rays do not appear to diverge again at once, but seem to form themselves into a thread which connects the convergent and divergent cones. Mr. Swinton showed that, if the divergent cone is thrown on to a thin platinum disk, it quickly attains a red heat. The disk usually becomes uniformly heated, but if an electric light carbon disk be employed, there is, in some cases, seen an apparently white hot ring with a well defined dark and seemingly cold interior. As the dimension of the cone of rays is varied by altering the vacuum, the ring alters correspondingly in diameter. Mr. Swinton has, also, been able to show that the converging cone of rays also acts under certain circumstances as if it were hollow. In order to investigate the cathode rays in a focus tube still further, and more especially in order to discover whether the various rays cross one another at the focus, or again diverge without crossing, Mr. Swinton showed a tube with a carbon anti-cathode which was also the anode, fixed at the opposite side of the focus from the cathode, with the focus about equally distant between it and the cathode. A section of the aluminum cathode, equal to about one-eighth of its total area, was removed. When the luminescent ring was produced, it was shown that instead of one-eighth of the circumference being wanting, actually seven-eighths were missing. The portion of ring that did appear was of a length corresponding exactly to the arc of the removed section of the cathode. Hence it appears that there is no rotation of the cathode beam as a whole, and that the rays do not cross at the focus; and further, that when the hollow convergent cone is, as it were, split in this manner, some unexplained action, similar in effect to a circular surface tension, causes the gap to widen out and the remaining portion of the ring-shaped section to contract correspondingly, without, however, altering its diameter. Another tube designed to investigate the same matter was shown. In this the cathode was of the usual form, but a small aluminum spike could be moved up and down the tube between the cathode and the anti-cathode. This piece of aluminum projected from the wall of the tube nearly to the center, and filled up very nearly one-quarter of the circular sectional area. On putting this obstacle slightly in the divergent cone, exactly one quarter of the ring



THE WIMSHURST INFLUENCE MACHINE AT THE ROYAL SOCIETY SOIREE.

on the anti-cathode failed to appear, and this result was maintained when the obstacle was moved farther into the cone. There was no displacement of the gap, and no rotation of the divergent cone. The point was then moved into the convergent cone of cathode rays, when a small portion of the ring on the carbon was cut out, but on the opposite side, showing that the rays cross one another's paths at the focus without rotation.

Mr. Swinton's experiments with X rays were directed to showing how the penetrative power could be varied to suit different conditions. It is known that as the vacuum is improved the rays become more penetrative, until a point is reached when the bones of the hand become almost as transparent as the flesh. Similarly at any degree of vacuum, the penetrative value is increased by increasing the power of the Ruhmkorff coil. Similar results can be obtained by varying the resistance of the tube by means of a magnetic field. The simplest method, however, is, as Mr. Swinton showed, by altering the distance between the cathode and anti-cathode. He had a tube in which the anti-cathode of aluminum, faced with platinum, was connected to the anode by a sliding steel rod, so that it could be moved along the axis of the tube, and the distance between the cathode and the center of the anti-cathode varied from 1 in. to 3 in., the anti-cathode being always outside the focus of the cathode. As the anti-cathode was moved toward the cathode, the penetrative value of the rays, as seen on a screen, was visibly increased, and when the motion was in the opposite direction, there was a corresponding decrease. Another tube had two cathodes, both focusing on opposite sides of the same platinum anti-cathode. The two cathodes were of different diameters, one being 0·375 in. and the other 1·125 in. With a degree of exhaustion that gave plentiful X rays with the small cathode in action, no X rays could be obtained by aid of the larger cathode. When the exhaustion was carried further, X rays of low penetrative power were produced from the large cathode, and rays of greatly increased penetrative power were obtained from the small cathode. In another lamp there were four anti-cathodes of different sizes, any one of which could be turned to face the cathode, and it was shown that the smaller the anti-cathode, the greater was the penetrative value of the rays. The penetrative value of the X rays produced by any given tube appears, therefore, to be dependent upon several conditions:

1. The penetrative value is higher for a high vacuum than for a low vacuum.

2. It is higher when the electrical power applied is great than when it is small.

3. It is higher when the resistance of the tube is great than when this resistance is reduced by magnetic means.

4. It is higher when the distance between the cathode and anti-cathode is small than when the distance is great.

5. It is higher when the cathode itself is small than when it is large.

6. It is higher when, as a consequence of one or more of the above, the potential difference between the cathode and the anode portion of the tube, and consequently the electrical excitation of the cathode, is great than when it is small.

Mr. Swinton's experiments attracted a large gathering all the evening, and excited the liveliest interest.

Another electrical exhibit of a curious and interesting nature was that of Mr. J. W. Swan. He showed a number of glass dishes containing resin covered with patterns of great complexity and much beauty. These were produced by placing the resin between two poles of an induction coil in action. No spark passes to the resin, which is merely subjected to strain, the spark being taken between an auxiliary pair of terminals. When the resin is removed it shows no trace of any effect. If, however, it be warmed through, the surface puckers up into patterns as the mass softens, owing to internal strains set up by the electric stress, which do not seem able to relieve themselves while the resin remains hard. These strains persist for a long time—for weeks, if not months.

Some of the samples shown had been developed three months after the resin was electrified. The patterns produced at the negative pole were quite different from those at the positive pole. Before the heating the plates were exposed to dust. In one dish there was a viscous mixture of resin and oil which flowed under electrification, and heaped itself up in various patterns.

Mr. James Wimshurst has lately constructed the machine which we illustrate. This, as will be seen, is of immense size—much larger than has ever been seen in London before—and gives torrents of electricity. Like everything shown by Mr. Wimshurst, it has been entirely designed by himself, and made in his own workshop, largely by his own hands. It is duplex in form, and on each side contains 12 plates, 30 in. in diameter; on each plate there are 32 sectors, the arrangement being such that the machine excites itself with absolute certainty before the handle has made a complete revolution. The length of spark is 32 in. between the two outer terminals, the large ball in the center forming a sort of half-way house between the two outer ones. The outside dimensions of the machine are 9 ft. in length by 2 ft. 9 in. in width.—Engineering.

EXPORTS TO LATIN AMERICA.

THE good ship Mexican Prince, which sailed from New York recently, had on board a somewhat diversified cargo, the details of which may do as a very fair illustration, says the New York Sun, of the variety of the cargoes sent from this city to South American ports. The notion is general that New York's chief exports to Europe are cereals, provisions, petroleum, and tobacco, and to South American ports machinery. But a mixed cargo to South American ports is a mixed cargo, indeed, if the case of the Mexican Prince may be taken as a sample.

There were 3 cases of refrigerators, 20 of bicycles, 11 cases of typewriters' supplies, 21 packages of empty bottles, 13 cases of baking powder, 20 cases of scales, 75 consignments of plows, 5 cases of tooth powder, 20 consignments of oars, 1 case of bird cages, 1 of slot machines, 81 consignments of pumps, 1 case of photographs, 27 consignments of hay presses, 12,000 boxes of matches, 2 bales of seed, 2 consignments of rakes, 4 consignments of emery wheels, 2 cases of cigarettes, 8 consignments of desks, 4 consignments of bedsteads, 4 consignments of cartridges, 80 boxes of clocks, 2 cases of towel racks, 31 harvesters, 1 case of phonographs, 24 boxes of soap, 40 stationary engines, 152 sewing machines, 60 cases of shoe blacking, 108 consignments of chairs, 11 cases of typewriters, 400 paper boxes, 3 consignments of firearms, 6 consignments of toys, 165 boxes of carpet tacks, 800 sets of harness, a bale of sponges, 39 cases of sandpaper, 377 packages of illuminating lamps, 5,000 pounds of candy, 15 machines for rice manufacture, 26 bales of wicks, 700 gallons of benzine, 100 pounds of confectionery, 1,000 gallons of naphtha, 1,000 yards of oilcloth, 377 consignments of cutlery and 200 bottles of American medical bitters.

On the same day the good ship Finance cleared for Central America with a mixed cargo of candles, hardware, photograph apparatus, stationery, paper, and drugs. Other items of American exports to South and Central America were cotton duck, sausages, pumps, codfish, hats, lamps, telephone receivers, perfumery, carts, bottled beer, clothes wringers, paints, staves, stove polish, bellows, whips, oleomargarine, cartridges, peanuts, tape, cider in barrels, coffee roasters, ice cream freezers, crucibles, twine, hoes, forks, oats, needles, wheaten grits, and netting. American exports to South and Central American cities are much more varied in kind than is usually believed to be the case. The exportation of agricultural implements is large to only one country of South or Central America—the Argentine Republic. American books are extensively exported to Brazil, coal to Cuba, machinery to Brazil, lard to nearly all South American ports, dairy products to the West Indies, wool to Honduras, wooden manufactures to Mexico, fish to the West Indies, cotton goods and wearing apparel of cheaper variety to the Central American states.

SOME SHIPS OF THE ANCIENTS.*

NOAH'S ARK.—The first vessel ever known to have floated on the face of the deep, as well as the largest, may well claim to have a first place among the most remarkable ships. Burchett, in his "Naval History," alluding to the ark, says, "To the immediate providence of God are we to attribute the invention of shipping." Beyond its dimensions and the object of its construction, we have but little record of this primitive vessel. The following is the description of the ark as given in the sixth chapter of Genesis: "And God said unto Noah, make thee an ark of gopher wood; rooms shalt thou make in the ark, and shalt pitch it within and without with pitch. And this is the fashion which thou shalt make it of: The length of the ark shall be three hundred cubits, the breadth of it fifty cubits, and the height of it thirty cubits. A window shalt thou make to the ark, and in a cubit shalt thou finish it above; and the door of the ark shalt thou set in the side thereof; with lower, second and third stories shalt thou make it." As Noah and his sons went into the ark in the "600th year of his life, in the 2d month, on the 17th day of the month," and left it in the "601st year, 2d month, 27th day of the month of his life," he must have inhabited the ark for a year and ten days. Allowing the usual measure of the cubit, which was one foot nine inches and eight hundred and eighty-eight thousandths, we find the ark was five hundred and forty-seven feet and a fraction in length, about ninety-one and a half feet beam, and was nearly fifty-five feet in height. Its tonnage has been variously estimated from twelve thousand tons to as high as forty-two thousand four hundred and thirteen tons. Dr. Hales, a writer in the Nautical Magazine, January, 1834, calculates its tonnage as eleven thousand nine hundred and five tons, and its external bulk one million five hundred and eighty thousand feet, which is nearly six thousand tons less than the capacity of that modern ark, the Great Eastern. The name would imply that it was coffer-shaped, or simply a square box, hence the calculation of its greatest tonnage, which would give it the capacity of eighteen line-of-battle ships, or about fourteen times the tonnage of one of the Collins steamships.

The ark was as long as St. Paul's Cathedral, London, nearly as broad and half as high. According to the biblical account, it was pitched within and without.

In length the ark was not remarkable, for it is exceeded by that of the Great Eastern and City of Rome, and several of our modern steamships are nearly five hundred feet long.

It would appear from the account in Genesis that it was one hundred and twenty years in building.† The wood of which the ark was constructed was "gopher wood," which has been translated cedar, pine, box, etc., but is generally supposed to have been cypress, that wood being least subject to decay, the sap of it being so offensive that no worm or other corroding animal will touch it.

The structure of the ark was adapted to the burden it was to carry and the weather it was to endure. We read that it had one door in the side, and that it had one window twenty-two inches square, which was rather a small allowance for light and ventilation, and that it had three stories, or, in other words, was a three-decker. Such is our limited knowledge of the first, and until our own times the greatest, ship the world has ever known.

Early in the seventeenth century Peter Jansen, a Dutch merchant, caused a ship to be built answering in its respective proportions to those of the ark. At first Jansen's ark was looked upon as a fanatical vision of his, and while it was building he and his ship were the sport of seamen; but afterward, says an old writer, "it was discovered that ships built in this manner were, in time of peace, beyond others, most commodious for commerce, because they would hold a third part more without requiring any addition of hands."

In length the ark was six times its breadth, which is about the proportion of the length and breadth of the large sea and war steamers of twenty years ago and of our modern clipper ships.

Whether the ark was of sufficient capacity to accommodate all the men and living things ordered into it, with the requisite provisions for twelve months, I shall not undertake to decide. It has been calculated that eight persons and two hundred and eighty pairs of quadrupeds (which, according to Buffon, is the utmost number of distinct species), with fowls, reptiles and insects that could not live under water, and all the necessary food for a year, could be easily admitted. Noah was instructed to make rooms, but, says the writer just quoted, "God's power was present, so that the harmony of the animals can be easily accounted for."

Not many years after the flood it became necessary for the descendants of Noah to construct vessels to convey themselves and their families to the territories allotted them.

The Isles of the Gentiles (Genesis x. 2–5) were assigned to the sons of Japheth, and Kittim, his grandson, according to Josephus, settled in the island of Cyprus, and from his name not only islands in general, but most maritime places, were in the Hebrew language termed "Kittim." The Isles of the Gentiles are supposed to have been the islands of the Mediterranean and Ægean Seas.

For the purpose of comparison we will state that the British steamship Inca was just half the length of the ark, and her other proportions the same, that is, her breadth was one-sixth the length and her depth one-tenth the length.

The largest vessel of war in the world in 1881 was the Italian ironclad Italia, which was four hundred feet long, had seventy-three feet beam and measured thirteen thousand eight hundred and ninety-eight tons. Her sister ship, the Lepanto, had the same length, three inches more beam, and measured thirteen thousand five hundred and fifty tons.

The largest merchant steamer and vessel in the world, in 1881, was the Great Eastern, which measured eighteen thousand nine hundred and fifteen tons and was six hundred and ninety-nine feet six inches long and eighty-two feet six inches broad.

The longest vessel in the world, in 1881, and the largest merchant steamer, save the Great Eastern, was the steamship City of Rome, whose dimensions were: Length, five hundred and eighty-six feet; breadth, fifty-two feet three inches; depth of hold, thirty-seven feet; tonnage, eight thousand eight hundred and twenty-six tons. Her weight was eight thousand tons, and her displacement at twenty-six feet mean draught was thirteen thousand five hundred tons.

Mr. James Napier devotes one section of his "Manufacturing Arts in Ancient Times" to a consideration of the particulars given in connection with the ark of Noah. According to the length of the "cubit" (either 18, 21 or 25·025 inches), the length of the vessel was from four hundred and fifty to six hundred and twenty-five feet, the breadth from seventy-five to one hundred and four, the depth from forty-five to sixty-two. The result given by calculations founded on the longest unit indicates a vessel fifty-five feet shorter than the Great Eastern, her length being six hundred and eighty feet; the lowest dimensions equal those of any vessel which we build at present for long sea voyages. He holds the opinion that the directions given in the sacred record were given in an age in which the art of shipbuilding had received considerable development. The proportion indicated—length six times the breadth—is that at present in favor in the construction of vessels designed to carry large cargoes with the greatest speed and to be capable of encountering heavy seas. "Looking at the whole structure from a workman's point of view," Mr. Napier remarks, "there would be required not less than twenty-five thousand loads of timber for its construction. The cutting down of such a number of trees as would be required, their conveyance to the building yard, the preparation of the wood for the timbers, of whatever shape they were, and the fitting of the different parts, indicate a great amount of skill on the part of the workmen. Whether the fastenings were of wood or metal we, of course, cannot decide; but, considering what we have seen of the knowledge of metals in ancient times, it is more than likely both were used." He concludes that the vessel was built upon some inland plane, contiguous to a plentiful supply of wood, an arrangement which would facilitate the collection of the cargo to be saved in the ark and account for the door in the side, as also for much of the derision of those who heeded not the preacher's warning. Mr. Napier challenges the popular notion that the waters rose gradually and steadily, the words translated "the waters prevailed" indicating that they bore down everything before them. Mr. Steinmetz, in his book on "Meteorology," concludes—from the statement that the water rose, in forty days and nights, to the height of fifteen cubits above the highest mountains—that the rate of rising was five inches per minute, or twenty-five feet per hour—sufficient to destroy every living thing in the space of half an hour. But, supposing the rate reduced to less than half, two inches per minute, no opportunity would even then have been afforded for hill climbing, as such a shower would have swept down everything movable before it. Ordinary seagoing vessels would not have furnished means of escape. "Even within our own day, in South America, earthquakes near the sea have been destructive to everything near them, and all vessels within the influence of the great wave have been destroyed, and these were but slight compared with the flood." The fact must also be considered that those who escaped would not have been likely, except in expectation of such a catastrophe, to have been provisioned for twelve months. The ark had probably then to encounter wind, waves and currents, and as a vessel without rudder in currents and wind always drifts side on, to the serious discomfort and jeopardy of every living creature on board, Mr. Napier infers that the vessel was provided with steering gear and means of propulsion. The phrase "God shut him in" does not preclude the idea that "Noah might have wrought his vessel as any captain would his ship," and "there being no apparent destination, the guidance would only be to keep it in the most favorable position for the comfort of the inmates." To the objection, "How could Noah and his three sons and their wives—eight persons in all—manage such a vessel by the ordinary means?" Mr. Napier replies, "The simplest explanation of the difficulty is that Noah and his sons,

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* By George Henry Preble, Rear Admiral U. S. N., in the United Service.

† From this and that the age of Noah is given as six hundred years it would seem that the word that has been translated as year must mean some other measure of time than the modern year. Perhaps a lunar month was meant, which would make the ark ten years under construction, and Noah's age about fifty when he entered the ark. A wooden vessel one hundred and twenty years in building would be rather rotten when finished.

like Abraham and the other patriarchs, are named as representing their households, and these included a great many servants, both male and female. Indeed, the invitation into the ark ['Thou and all thy house'] suggests this. There are many instances of this use of language in the Old Testament history where only the head of the house is named singly, but historically he represents his whole family and adherents. The Chaldean tablet states that there were many people along with the person named—the Noah of the Bible; and as we have shown that this is not only not contrary to the Scripture account, but essential to it, we accept it as strong evidence of the correctness of our opinion." To the objection that might be urged that this explanation minimizes the amount of miraculous intervention ordinarily associated with the preservation of the ark and its inmates, Mr. Napier replies that "a continued miracle is contrary to God's way of dealing when the effect can be obtained under the ordinary laws."

The Leontophorus, mentioned in Memnon, and related as translated by Palmerius, was a ship admirable as well for its beauty as its bulk; it had eight tiers of oars, one hundred in each tier—eight hundred on each side, and in all sixteen hundred: This passage and some others have occasioned a great controversy among antiquarians, whether there were more than one man at the long oars of ancient ships, it seeming a thing impossible for such long oars to be managed by one man.

Demetrius Poliorcetes seems to have been the best shipbuilder among the ancients. Plutarch reports that the bulk of his ships surprised his friends, and their beauty created some delight in his enemies. He built two ships of sixteen and another of fifteen ranks (banks?) of oars, which moved as easily as those of lesser size; and warlike machines for sieges so well contrived that they astonished his enemies; so that Lysimachus, his mortal foe, having obtained the power of seeing his ships and machines, surprised at the contrivance, cried out that they were built with more than human art.

A very extraordinary ship was built by Caligula, adorned with jewels in the poop, sails of many colors, large porticos, bagnios or baths; rooms for entertainments richly furnished, also decorated with vines and fruit trees in nice order. This ship foundered in the sight of Claudius, and was irrecoverably lost in the port of Ostia.

Athenæus* gives a list of the fleet of Ptolemy Philadelphus, viz.: Two of thirty tiers of oars, one of twenty, four of thirteen, two of twelve, fourteen of eleven, thirty of nine, thirty-seven of seven, five of six, seventeen of five, four of three and a half tiers, which were called triememiolia. The rest of the ships which were distributed about the whole empire were above four thousand.

THE ALEXANDRIA OR ALEXANDRIAN.—This celebrated vessel, built for Hiero, King of Syracuse, under the direction of Archimedes, intended for a corn trader, was at first called the Syracuse; but when Hiero presented her to Ptolemy he named her the Alexandria. She was built during or preceding the siege of Syracuse, which terminated 213 B. C., and though armed for war, had all the sumptuous fittings of a pleasure yacht, and yet was ultimately used to carry corn. Her dimensions are not given.

This ship, famous in ancient times, and a wonder even now, was the subject of a particular treatise by Moschion, the substance of which has been fortunately preserved by Athenæus, and is here presented: For the making of this ship (he tells us) there was cut down on Ætna so much timber as would have made sixty ordinary galleys; besides which the wood for treenails, ribs, and knees was procured from other parts of Sicily and from Italy, and materials for cordage were fetched from Spain and the river Rhodanus, as were other necessaries from other places. King Hiero, having hired shipwrights and other workmen for their services, placed Archias, a Corinthian architect, over them, but all under the supreme direction of Archimedes; and exhorting them to carry on the work diligently, and, to encourage them in it, he would be whole days present at their labor. The number of men employed was three hundred master workmen, besides their servants, who in six months built the ship up to the half of its designed height; and as the several parts were finished they covered them with sheet lead to preserve them from the injuries of the weather. When thus far advanced Hiero ordered her launched, that the rest of the work should be perfected afloat; but how to get this vast pile into the water they knew not, until Archimedes invented the engine called the helix, by which with a very few hands he drew the ship into the sea; when in six months more she was entirely completed and driven full of large nails of brass, many ten pounds weight and others of fifteen, which were let into the timbers by large auger holes, to rivet them well together, and covered on the outside with pitched cloths, over which were nailed plates of lead.

The ship had twenty-five banks of oars and three decks, to the lowest whereof next the hold there was a descent by several pairs of stairs. The middle deck had on each side of it fifteen apartments for dining, each furnished with four couches such as are used to recline on at their meals. On the same deck was accommodation for the mariners, having fifteen couches and three large chambers for men and their wives, each having three beds; next which was the kitchen on the poop, the floors of all which were paved with mosaic, representing the whole story of the Iliad. Suitable to so rich a floor was the workmanship of the ceilings and door to each apartment. On the upper deck was a place for exercises and a fine walk, wherein were several garden plots furnished with plants of all kinds, which were watered by leaden pipes laid to them from a great tank or reservoir of fresh water, where were also arbors of ivy and vines set in hogsheads of earth, whose roots were in the same way watered. Next to these was a department devoted to the pleasures of love, the pavement of which was of agate and other of the richest stones that were found in Sicily. The roof was of cypress wood, and the doors of ivory and the wood of the almond tree. It had three beds in it, and was richly adorned with pictures, statues, and drinking vessels of exquisite workmanship. Adjoining this was a room for retirement and conversation, which was furnished with five couches and wainscoted with box, having doors of the same wood. Within this there was a library, and in the ceiling thereof a fine clock made in imitation of the great dial of Syracuse, as also a bagnio or bath with three brass cisterns, and a bath which held forty gallons, adorned with gems called tauromenites. There were also a great number of cabins for the marine soldiers, together with twenty stables for horses, ten on each side of the deck, and good accommodations for the horsemen and grooms. In the forecastle was the tank for fresh water, made of planks well lined with cloth and pitch, which held two hundred and fifty-three hogsheads, and near it was a well lined with sheet lead, which, being kept full of sea water, nourished great numbers of fish. From the ship's sides there jutted out several beams, whereon were made places for keeping wood, as also ovens, kitchens, mills, and other necessary offices, each of which beams was supported on the outside by a carved image nine feet high.

The whole ship was handsomely painted. She had eight wooden towers, two on the forecastle, two on the poop, and the remaining four amidships; from each of these there jutted out two beams, whereon was raised a breastwork full of loopholes, from whence an enemy might be annoyed with stones. Each tower was full of those and other missive weapons, and was constantly guarded by four soldiers completely armed, with two archers. On this upper deck there was also raised a stage with a breastwork around it, whereon was placed a machine invented by Archimedes which would fling stones of three hundred pounds weight and darts eighteen feet long a distance of a hundred and twenty paces. Around this machine were hung by chains of brass curtains composed of large cables for its security. The ship was furnished with three masts, and each of them with two engines for throwing stones, from whence also large iron hooks and dolphins of lead were to be flung into an enemy's ship. It was also fortified with an iron palisade all around to prevent an enemy's boarding, and had grappling irons in readiness in all quarters wherewith to seize and bring to such hostile vessels as it might be engaged with. Sixty soldiers completely armed kept constant guard on each side of the ship, and as many at each of the masts and their respective engines. The "round tops" were of brass, and constantly guarded by three men in the main and two in each of the others, to whom, in case of action, stones were to be conveyed in baskets by the help of certain tackle for that purpose, and they were to be supplied with darts and arrows by boys appointed to that service. The fore and mizzen masts for this marine monster were without difficulty procured in Sicily, but a main mast of proper dimensions was hard to be got, until one was at length found in the mountains of Britain by a swineherd, which was brought down to the sea by Phileas, an engineer of Tauromenium. The ship was furnished with four anchors of wood and eight of iron, and though her sentena or sink was of so great size and depth, its one pump, by a device of Archimedes, was able to empty it managed by only one man. She had several tenders to accompany her, one whereof was a galley called the Cercurus, and the rest fishing boats and other small vessels. Her whole company was a great multitude, there being on the forecastle alone six hundred seamen always in readiness to execute such orders as should be given. The power of punishing all faults and misdemeanors done on board was committed to the captain, master, and master's mate, who gave sentence according to the laws of Syracuse. There were put on board of her sixty thousand bushels of corn, ten thousand barrels of salt fish, twenty thousand barrels of flesh, and as many bales of goods and necessaries, besides all the provisions for her company. Hiero, or Hieron, finding all his harbors either very dangerous for a ship of so vast a burden or else not capable at all to receive her, came to the resolution of presenting her to Ptolemy, King of Egypt, to whom she was accordingly sent and towed in safety to Alexandria.

This Ptolemy, who was surnamed Philopater, was already possessed of two ships of extraordinary dimensions, of his own building, which will be described hereafter. After the arrival of the Syracuse at Alexandria, she was hauled on shore, and nothing further is recorded of her. We may add that Archimelus, a Greek epigrammatist, wrote a little poem on the large vessel, which was rewarded by Hiero with a present to its talented author of one thousand measures of corn—a premium proportioned, if not to the poem, at least to the magnitude of the theme celebrated.

THE ISIS.—Still earlier than this hulk of Ptolemy's was the Isis, built by the Egyptians. She was one hundred and eighty feet in length, forty-five feet in breadth, and forty-three in perpendicular height from the bottom of the pump well. This vessel did not differ materially in form or dimensions from an English first-rate built at the close of the last century, except that she was rather larger in proportion to her breadth of beam. Her tonnage has been calculated at one thousand nine hundred tons.

PTOLOMAUS PHILOPATER'S TWIN WAR SHIP.—The description of a grand and magnificent war ship built by Ptolmaus Philopater, king of the Grecian-Egyptian empire from 221 to 204 B. C., its construction, equipments, and process of launching it, etc., is furnished by Athenæus in his fifth book.* Her tonnage, builders' measurements, has been estimated at six thousand four hundred and forty-five tons, and her external bulk eight hundred and thirty thousand seven hundred cubic feet.

"Philopater built a ship with forty ranks of rowers, being two hundred and eighty cubits (five hundred and sixty English feet) in length and thirty-eight cubits (seventy-six feet) from one side to the other; and in height up to the gunwales it was forty-eight cubits (ninety-six feet), and from the highest part of the stern to the water line fifty-three cubits (one hundred and six feet); and it had four rudders, each thirty cubits (sixty feet) long; and oars for the thranitæ, the largest thirty-eight cubits (seventy-six feet) in length, which from having a lead in their handles, and because they were heavy in the part inside the ship, being accurately balanced, were, in spite of their bulk, very handy to use; and the ship had two heads and two sterns, and seven rostra or beaks, one of which was larger than all the rest, and the others were of smaller size, and some of them were fixed to the ears of the ship; and it had twelve undergirths to support the keel, each six hundred cubits in length. And it was well proportioned to a most extraordinary degree; and all the appointments of the vessel were admirable, for it had figures of animals in it not less than twelve cubits in size, both at the head and at the stern, and every part of it was inlaid and ornamented with figures in wax; and the space between the oars down to the very keel had a running pattern of ivy leaves and thyrsi; and there was a great store of every kind of equipment to supply all parts of the ship that might require any. And when it put to sea it held more than four thousand rowers and four hundred supernumeraries, and on the deck were three thousand marines, or at least two thousand eight hundred and fifty. And besides all these, there was a large body of men under the decks, and a vast quantity of provisions and supplies. The vessel was launched originally from a sort of framework, which was created and made out of the wood of fifty ships of five ranks of oars; and it was launched by the multitude with great acclamations and blowing of trumpets. But after that the Phenician devised a new method of launching it, having dug a trench under it equal to the ship itself in length, which he dug close to the harbor. In the trench he built props of solid stone five cubits deep, and across them he laid beams, running the whole width of the trench, at four cubits distance from each other; and then making a channel from the sea, he filled all the space which he had excavated with water, out of which he easily brought the ship by the aid of whatever men happened to be at hand; then closing the entrance which had been originally made, he drained the water off again by means of engines, and when this had been done the vessel rested securely on the aforementioned cross beams."

The Thalamegus, a river vessel, also built by Philopater, is described by Athenæus:

"Philopater also built a vessel for the river, which he called Thalamegus, or the carrier of his bed chamber, in length half a stadium (or three hundred feet English), and in width at the broadest part thirty cubits (sixty feet), and the height, together with the frame for the awning, was little short of forty cubits (eighty feet); and its appearance was not exactly like ships of war nor merchant vessels either, but it was something different from both on account of the necessity imposed by the depth of the river, for below it was flat and broad, but in its main hull it was high, and the parts at the extremity, and especially at the head, extended a sufficient length, so as to exhibit a very pretty and elegant sweep. This ship also had two heads and two sterns, and it rose to a considerable height above the water, as was necessary, because the waves in the river often rose very high. In the middle of its hull were constructed banqueting rooms and sleeping rooms, and everything else which may be convenient for living in, and around the ship were double corridors running about three sides, each of which was not less than five plethra in circumference. The arrangement of the lower one was like a peristyle, and that in the upper part was covered in and surrounded with walls and windows on all sides. When you first came into the vessel by the stern your eye was met by a colonnade open in front and surrounded by pillars, and opposite to it in the bow of the vessel there was a sort of proscenium covered in overhead. Again, in the same way, in the middle of the vessel, was another colonnade open behind, and an entrance of four folding doors led to it. Both on the right hand and on the left there were windows admitting a pleasant breeze. To these was joined a room of very large size, and that was adorned with pillars all around, and it was capable of containing twenty couches. The greater part of it was made of split cedar and of Milesian cypress, and the doors which were around it, being twenty in number, were put together with beams of citronwood having ivory ornaments. All the nails and fastenings which were visible were made of red brass, which had taken a polish like that of gold from the fire. The whole of the capitals of the pillars were of gold, and there was a sort of girdle on them having figures of animals beautifully carved in ivory more than a cubit (two feet) high, of which the workmanship was not so conspicuous as the exquisite beauty of the materials. There was a beautiful roof to the banqueting room, square, and made of cypress wood; its ornaments were all carved, having a golden face. Next to this banqueting chamber was a sleeping chamber holding seven couches, and to that there was joined a narrow passage, which separated the women's chamber from this one by the width of the hold. By the passage was a banqueting room holding nine couches, very like the large one in the sumptuousness of its furniture, and a bed chamber holding five couches. As to the rooms then on the first deck, this was the general appearance presented. But when you had ascended by the stairs, which were close to the before mentioned sleeping chamber, there was another chamber capable of containing five couches, having a vaulted oblong roof. Near it was a temple of Venus, in form like a rotunda, in which was a marble statue of the goddess. Opposite to this chamber was another banqueting room, very sumptuous, adorned all round with columns, for the columns were all made of Indian stone. Near to this banqueting room were sleeping chambers, with furniture and appointments corresponding to what has been already mentioned. As you went on toward the head of the vessel was another apartment dedicated to Bacchus, capable of holding thirteen couches, surrounded by pillars, having its cornices all gilt as far down as the epistyle, which ran round the room, but the roof corresponded to the character of the god. In it there was at the right hand a large cave constructed, the color of which was stone—for, in fact, it was made of real stone and gold—and in it were images placed of all the relations of the king made of the stone called lychnites. There was another banqueting room, very pleasant, above the roof of the greatest apartment, having an arrangement like that of a tent, so that some of it had no actual roof; but there were arched and vaulted beams running along the top at intervals, along which purple curtains were stretched whenever the vessel was in motion. After this there was an open chamber occupying the same room above that occupied by the portico before mentioned as being below, and a wind-

* See Bohn edition.

* See Bohn's edition, vol. iii.

ing ladder joined on to it leading to the secret walk, and a banqueting room capable of containing nine couches, constructed and furnished in the Egyptian style. Four round pillars were run up in it, with alternate tambours of white and black, all placed in parallel lines, and these heads were of round shape, and the whole of the figures round them were engraved like roses a little expanded. Round that part which is called the basket there were not tendrils and rough leaves, as is the case in Grecian pillars, but calyxes of the river lotus and the fruit of newly budding dates, and sometimes many other kinds of flowers were also represented. Under the roof of the capital, which lies upon the tambour where it joins on the head, there were ornaments like the flower leaves of the Egyptian bean intertwined together. This, then, is the way in which the Egyptians construct and ornament their pillars, and this is the way in which they variegate their walls with black and white bricks, and sometimes also they employ the stone which is called alabaster. There were many other ornaments all over the main hall of the vessel and over the center, and many other chambers and divisions in every part of it. The mast of this vessel was seventy cubits (one hundred and forty feet) in height, and it had a linen sail adorned with a purple fringe."

HEAVY TANK LOCOMOTIVES FOR THE INDIAN STATE RAILWAYS.

THE engines illustrated herewith were manufactured by Messrs. Neilson & Company, Hyde Park Locomotive Works, Glasgow, for the Mushaf Bolan section of the Northwest Indian State Railways, to the designs of Sir A. M. Rendell, Westminster. They are intended to work on gradients of 1 in 25, and will traverse curves of 600 ft. radius. The total weight of the engine in working order is over 92 tons, and as the greatest weight per axle is restricted to 17¼ tons, four pairs of coupled wheels are required to give the necessary adhesion for the cylinder power. The engine is capable of taking a load of 220 tons exclusive of its own weight up a grade of 1 in 25. In India the water in the tanks gets so hot that there is sometimes difficulty in feeding with the injectors; in addition, therefore, to one injector, a donkey pump capable of feeding the boiler with water at 180° is fitted to the engine.

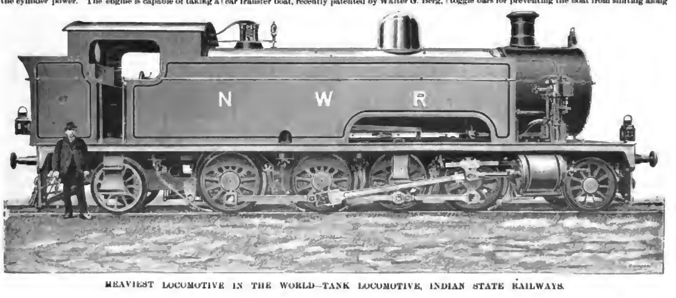
The principal dimensions of the engine are as follows:

Diameter of cylinders	20 in.
Length of stroke	26 in.
Diameter of coupled wheels	4 ft. 3 in.
	Square feet.
Heating surface in tubes	1942
Heating firebox	148
Total	2090
Area of fire grate	30·22
Contents of tanks	2300 gallons
Fuel space	190 cubic feet
Fixed wheel base	16 feet
Total wheel base	31 ft. 3 in.
Boiler pressure	180 lb. per sq. in.

Weight with tanks full, two tons of coal in bunkers, and in working order:

	Tons.	Cwts.	Qrs.
Leading radial	8	13	0
Leading coupled	17	8	1
Intermediate coupled	17	8	1
Driving	17	9	0
Trailing	17	6	3
Hind radial	13	16	2
	92	1	3

This is, we believe, the heaviest locomotive in the world.—The Engineer.

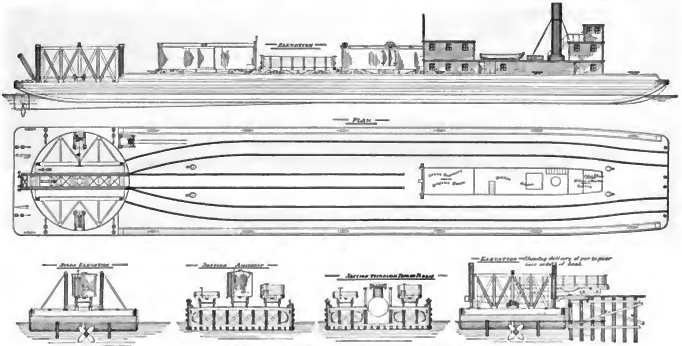


HEAVIEST LOCOMOTIVE IN THE WORLD—TANK LOCOMOTIVE, INDIAN STATE RAILWAYS.

BERG'S SPECIAL DELIVERY CAR TRANSFER STEAMER.

THE illustration represents a special construction of car transfer boat, recently patented by Walter G. Berg, member of the American Society of Civil Engineers, No. 261 West Fifty-second Street, New York City. The boat is provided with its own propelling machinery and with suitable mechanical appliances to allow a car on the boat to be raised to a proper height to be shunted ashore on a piece of track laid on the floor of the pier or bulkhead, which track need not be longer than necessary to hold a car or may be extended and carried into and through the consignee's establishment. By the special elevating and landing mechanism the car may be delivered either over the stern of the boat or on either side, cars being similarly transferred from land to the boat.

The illustration shows in plan, elevation and sectional views a transfer boat which may be made of a size suitable for ten or thirteen 38 ft. cars, each of 80,000 pounds capacity, in the latter case the boat being 38 ft. 6 in. wide and about 240 ft. long. The boat is to be propelled by a single screw driven by the usual class of marine engine and boiler at a speed of about ten miles an hour, and the extreme lift of the elevator is designed to be 10 ft. 6 in. As will be seen, the boat has on its deck three lines of railroad tracks, similar to those of the present car transfer boats, and at the stern of the boat is a turntable on which cars may be run from the tracks. The track on the turntable is supported by an independent platform that can be raised with the car on it above the deck of the boat, and lowered again to the deck of the boat at will. There is a swinging apron attached to one end of the platform, with suitable adjustable rail connections, etc., allowing a proper connection to be made with the rails of the track ashore. The turntable is designed to be turned by a wire rope winding drum, and the car may be moved along the deck to or from the turntable by rope haulage steam winch heads. The elevating platform will be raised by hydraulic power, working in cylinders on the turntable. The apron is raised, lowered, or locked in any position by special mechanism, and the boat is provided with chocking and chaining fixtures for holding the cars, locking latches for the turntable, toggle bars for preventing the boat from shifting along



SPECIAL DELIVERY CAR TRANSFER STEAMER.

United States Patent No. 576,941, February 9, 1897. Walter G. Berg, Patentee, 261 West Fifty-second Street, New York, N. Y.

the pier, and moving fixtures for tying up to the shore. It is designed that the crew, coal consumption, and operating supplies will be practically about the same as required on a regular large tug boat carrying the same class of propelling machinery.

INGLIS' TRIPLE EXPANSION PADDLE-WHEEL ENGINES.

WE illustrate herewith a type of triple expansion engines which Messrs. A. & J. Inglis, of Glasgow, have fitted to several paddle-wheel steamers during the past ten years, attaining, with each, a full measure of success consistent with the long record of the firm. The first steamer fitted was the Ramapoora, completed in 1887 for service in Indian waters. Since then four other large vessels have been fitted with similar engines, and the firm have just completed engines of 600 indicated horse power for two steamers for the River Steam Navigation Company, of Calcutta, and three others for small vessels abroad are in hand. As an indication of the relative space occupied, it may be said that these latter new engines will actually occupy less width athwartship than the old compound engines originally in the vessels.

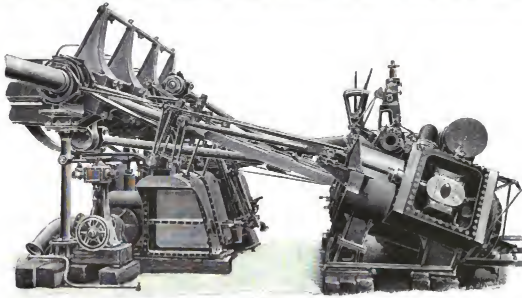


FIG. 1.

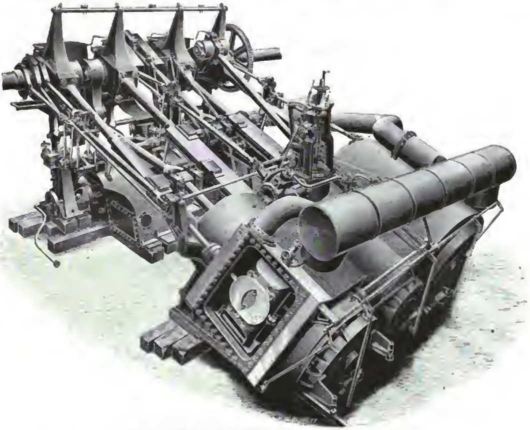


FIG. 2.—INGLIS TRIPLE-EXPANSION PADDLE ENGINES.

The engines illustrated are typical; since the first set was designed, only very slight alterations have been made. In the set placed in the Ramapoora the high pressure engine crank led, with the intermediate next, and the low pressure last; in subsequent cases the low pressure leads, followed by the intermediate and the high pressure. The practical results, either in respect of economy or efficiency, were not, however, affected by the change. In other respects the engines are identical. A noticeable point is that Messrs. Inglis have maintained their preference for the ordinary double eccentric motion, with Gooch's arrangement of stationary link, which has been so largely used in locomotive practice. To reverse the engine, the intermediate radius rod or link is shifted by means of the usual reversing shaft actuated by Brown's engine, so as to bring the quadrant block in line with the astern-going eccentric rod. It will be noticed that the suspension links oscillate on the reversing shaft as a center, and are coupled to the reversing quadrant at a point coincident with the attachment of the ahead-going eccentric rod. For an engine working generally in full gear ahead, this gives a smooth running gear with little motion of the block in the quadrant. Messrs. Inglis have adopted the Gooch stationary link gear for thirty years in paddle engines. It is interesting to note, in connection with the engines illustrated, that the firm have been able to get their triple engines into the steamer without adding to the space occupied by the compound engine, and that, too, without resorting to any but well tried gear.

The engines of the paddle steamer Paris, built for the Messageries Fluviales del Plata, and illustrated by us, occupied a width over the casing of 20 feet; they were designed to develop 2,500 indicated horse power while running at about 32 revolutions. The Rasmara was a repeat order of the Ramapoora, the second ship being completed in March of 1890. The Paris was the third paddle steamer fitted by Messrs. Inglis for the River Plate Company, the first two, the Helios and Triton, being built by the Scotswood Shipbuilding Company, Newcastle, in 1892 and 1894 respectively. The other vessels were constructed at the Pointhouse yard of Messrs. Inglis.

The cylinders are steam jacketed, and the high pressure is fitted with a piston valve receiving steam in the inside, while the intermediate and low pressure cylinders have double ported slide valves arranged, as shown, on the outside, so that they can be easily overhauled. The pistons are of steel, with a special packing adopted by the firm and arranged to give the least possible friction. The piston rods and valve spindles are fitted with metallic packing. The piston rods are made from Siemens-Martin steel ingots, but the connecting rods are of malleable iron. The main columns are of forged steel, and are made so as to form the guides for the piston rods. The entablature is of steel, and the construction can be seen by reference to the illustrations. These points, it may be said, indicate the usual practice at the Whitehall foundry of Messrs. Inglis. The crankshaft is in one piece and 16½ inches in diameter. It has long bearings of hard gun metal.

The wheel—arms and floats—is constructed of Siemens-Martin steel. The diameter is 21 feet over the floats, of which there are eight of 11 feet 6 inches width by 4 feet. Of course they are of the feathering type, and as is sometimes, although not invariably, the case with Messrs. Inglis' engines, there is no outer ring. This gives convenience in overhauling if it does not also minimize the repairs necessary after the wheel has collided with obstructions, when a ring is likely to get badly damaged.

The condenser is of cast iron and forms a support for the pumps and valve motion as shown. The tubes, ¾ inch in diameter, are of brass, and the tube plate, 1¼ inch thick, is of Muntz metal. The air pumps are brass and are worked from the high pressure crosshead. The circulating pumps are of the centrifugal type, by Gwynne, and are driven by a separate engine.

In connection with the Paris it is interesting to state, although it is not shown on the drawings, that the cylinders are fitted with a special cut-off gear, so that the cut-off may be as early as 10 inches to 12 inches of the stroke in the high pressure cylinder. This is arranged by a drop double beat valve, actuated by an eccentric and slip catches driven from the main shaft. It may be brought into use at any time, almost instantly, whenever it is desired to have an early cut-off.

The four boilers fitted are single ended, the diameter being 11 feet and the length 11 feet 3 inches. There are eight furnaces, 3 feet 6 inches in diameter inside measurement, and the tubes are 2¼ inches in diameter, the ratio of stay to fire tubes being 1 to 5. The grate area is 140 square feet and the heating surface 5,150 square feet. Howden's system of forced draught is fitted, and the boilers are arranged so that any two may be used independently of the others.

The trials of the Paris were conducted in midwinter in squally weather, with the ship fully loaded. The results given are the mean of four runs on the measured mile; indicated horse power, 2,200; revolutions, 32 per minute; speed, 16 knots. On a full power run 2,500 indicated horse power was exceeded.

To judge from the splendid finish of the saloons of the Paris, it is pretty evident that even in the unsettled regions which Europeans lump as South America, the trend is toward more luxurious surroundings afloat, and it is safe to assume that nothing like the Paris has as yet been seen on the Plate. Accommodation is provided chiefly for first-class passengers and for a few second-class. There are four decks — promenade, saloon, main and lower—and on the saloon and main decks one can accurately measure the advance on her predecessors which the new boat represents. The saloon deck shows the first-class Clyde shipbuilder at his best. The dining saloon and a large number of the staterooms are on this level, and, speaking broadly, the apartment from which access is obtained to them is the length and breadth of the ship. Amidships the engine space breaks the continuity, but forward of the obstruction there is a commodious and handsomely fitted dining saloon, and aft there is an apartment of similar size, which may be used as an auxiliary dining room, but will probably be utilized as what is termed on liners a "social hall." Wide corridors, in which are sofas and chairs, connect the two. The fittings throughout the ship are of the latest and most complete description, but on the saloon deck decorative art, as it is known in shipbuilding, is carried to very nearly perfection. The panelling is all in light wood, with hand-painted panels and a finely carved gilt cornice. The fanlights are also hand painted, and the glass panels of the stateroom doors are similarly treated. The sofas, chairs, etc., are upholstered in Utrecht velvet. There is a complete installation of electric light, so complete, indeed, that it supersedes even the candles on the piano in the forward saloon and in the organ in the after.

Among the novelties on board is a set of aluminum boats. The tackle blocks for lowering these are of the same metal, which is also largely used in some of the minor fittings usually classed as "ironmongery." Lightness and strength combined have been studied with unusual care, and to insure these qualities a large number of special sections of rolled steel have been employed in the construction.—Engineering.

INSECTICIDES AND HELPFUL AGENCIES.*

THE florist has his share of the insect world to fight; in fact it seems as though he had much more than his share, for insects multiply the year round, and so very rapidly in the warm and humid atmosphere necessary to forced plant growth. Many of the insecticides in use on the farm cannot be used on house plants, because the later are too delicate and tender. This has given rise to a great many patented insecticides, or remedies, composed of unknown ingredients which are sold under attractive names at fabulous prices. Many of them are valuable and worth the price, while others are valueless or worse than nothing. After all, there are usually simple, cheap and efficient remedies to which we return after our vain search for a panacea among the compound mixtures.

Water.—The florist appreciates the value of this simple and often very effective agent in insect control. In wetting the plants, a hose with a good nozzle attachment is used, so that the water can be thrown with force upon all parts of the plants, and so beat off many of the little pests that are lurking under the leaves or on the stems. More than this is rarely needed for the red spider, and many of the aleyrodes and male mealy bugs are also killed by this method.

In a home conservatory, or in the home where only a few plants are kept, the above method is rarely practicable, but hot water is even a better antidote for these troubles than cold. If once thoroughly tested, it will be found to be most valuable; it is always at one's command, costs nothing, and with a few moments' heating is ready for application. The plant is left clean and free from any bad effect if the water is not raised to too high a temperature. From 130° to 135° F. is sure death to most insects, while few plants are harmed by water at 150° F., the scalding point. Even the coleus, one of the most delicate of plants, is not injured by water at 150° F. On the more hardy plants, such as the cabbage, we know that water at 180° F. does them no harm. By the use of a thermometer, heat the water to 140° or 150° F., and then dip the plants into it quickly two or three times. If preferable, use a sprinkler or spray pump without a nozzle; but remember that the water must strike the insects to affect them, and to be effectual it must be at a temperature between 130° and 150° F. when it strikes them. Water cannot be thrown in a spray, as it cools too rapidly.

Tobacco.—There is perhaps no other substance in such general use for insects in the greenhouse, particularly the aphis, as tobacco in its various forms. The waste or hard parts of the tobacco leaves, known as "stems," can be obtained from cigar factories for almost no cost, and are quite as valuable an insecticide as the more expensive tobacco. The use of it as a smoke or vapor is the only practical method of application. When wanted for fumigating, the stems should not be so dry that they will blaze, but rather smolder and generate a large volume of smoke. They may be moistened at the time of using, but preferably should be kept in a moderately damp place where they will be evenly moistened throughout. Occasionally tobacco dust may be secured as cheaply as the stems, and for burning this will be found superior to the stems in some respects. Probably the best time to fumigate is late in the afternoon on a still day, as too much wind outside will usually drive the smoke to some extent inside. This, too, will leave the tobacco fumes in the house overnight, and the full effect will be derived from them. The tobacco may be burned in various ways. Some use sheet iron buckets for holding the tobacco, others place it on the earth or cement floor and burn it there. The Elmira (N. Y.) florist, Mr. Grove P. Rawson, writes that an occasional shovelful of live anthracite coals from the furnace spread over the tobacco dust serves him the best of anything. The amount of tobacco to be used and the frequency in using must be left largely with the operator in each individual case, as the kind of plant to be treated, the tightness of the house, the strength of tobacco, and the abundance and kind of insects all tend to vary the amount and time.

Within the past two or three years vaporized tobacco has largely superseded tobacco fumes. By those who have tested both, the vapor is considered much superior and more effective on the aphis. Where steam is used for heating, the treatment is very simple. The tobacco stems are placed in a kettle or barrel; a hose is then connected with one of the steam pipes, the other end is inserted into the kettle, and the steam does the rest. The house is very quickly saturated with the tobacco vapor and the work soon over. Surplus moisture of course is the item to be feared in this treatment, and to prevent mildew, florists are generally agreed that the treatment should be given early in the morning on a bright day, and as soon as it is finished the plants should have their regular syringing and the house be ventilated.

Another method of vaporizing that has many adherents is to apply liquid tobacco directly to the outer surface of the steam pipes and allow it to evaporate. The Louisville Spirit-Cured Tobacco Company, of Louisville, Kentucky, recommend this method for the use of their liquid tobacco extract, and it has given excellent satisfaction as far as we have been able to ascertain.

Our college greenhouse is heated by hot water, and with us the vaporization of tobacco is not as practicable as fumigation, owing to the pipes remaining at too low a temperature. A fair substitute for steam is a hot brick dropped into the liquid extract. Evaporating over an oil stove is too slow to be recommended.

Kerosene Emulsion.—For the hardy ornamental plants out of doors and the more hardy ones indoors, kerosene emulsion may be used. On the more delicate plants it must be used with great caution, if at all. There is quite a question in the mind of the author whether it should be even recommended when there are other good and safer oil and soap washes that may be substituted.

For those who care to use the emulsion, the following formula may be followed:

Soft Soap Formula.—Heat a gallon of soft soap until it becomes liquid; then take from the fire, add two quarts of kerosene and agitate for three or five minutes so thoroughly that the soap and oil become permanently mixed—that is, until the oil will not separate from the soap either on standing or when diluted. A hand force pump should be used in making the emulsion. Slow pumping or stirring with a stick or spoon will not emulsify the soap and oil.

The emulsion as made is now one third oil, and for the plants it should be only one-fifteenth oil. So it will need four times its own bulk of water before using. In other words, the gallon of soap and two quarts of oil will make seven and one-half gallons of the dilute emulsion.

If the emulsion is to be made in the above or greater quantity, it should always be made with soft soap, if that is obtainable, as the emulsion is more difficult to make by the hard soap formula, where more water is required.

Hard Soap Formula.—To two quarts of water add one fourth pound of hard soap, heat to the boiling point, and when the soap is dissolved add the pint of kerosene and proceed as in the soft soap formula. This is one-fifth oil and should be diluted with twice its own bulk of water before using.

Fir Tree Oil.—This is a penetrating oily liquid which is one of the best insecticides that we have found for such insects as the mealy bug, thrips, red spider, aleyrodes, and young scale. It can be procured through florists or dealers in florists' goods. The cost is one dollar per quart. This is rather high priced, but when one has but a few plants the treatment will not be expensive. When used at the rate of one-half pint to a gallon of water there is danger of injuring the most delicate plants. At the rate of two-thirds of a pint to a gallon of water ferns are the only plants on which we have tested it that are injured. This last proportion is much more effective on mealy bugs and aleyrodes than the weaker mixtures. One of the great pleasures derived from the use of this mixture, besides that of killing the insects, is the fine condition in which it leaves the foliage. There is a bright, clean luster that reminds one of new foliage.

Some florists apply the undiluted oil on the scale insects with a small brush and find it very successful, though a little slow.

Fir Tree Oil Soap.—This is a soap prepared from the fir tree oil and is sold, as far as we know, only by J. C. Pierson, of Newark, N. J. It has all the qualities of the fir tree oil, and, if anything, can be used stronger on the plants than the oil without injury to them. It should be used from three to five times as strong as recommended by the agency to secure the best effect, or, in other words, from three to five ounces to each gallon of water. This makes the expense about ten to fifteen cents per gallon, which is, at that strength, less than the cost of the oil. The soap dissolves readily in soft water upon heating slightly, and leaves the foliage with a glossy luster.

Whale Oil Soap.—We used the whale oil soap in comparison with the last two substances, and find that, while it is much cheaper than either of them, it is also inferior in several respects. If made strong enough to be as destructive to insect life, it is more liable to injure the foliage of the more tender plants, and when used very strong it leaves the foliage more dirty and with white, soapy, mildewlike spots on the leaves. When used at the rate of one-fourth pound to a gallon of water there was no injury to plants; one-half pound to a gallon injured the foliage of several tender plants.

Soft water should be used with all of these soap and oil washes.

Cole's "Insect Destroyer."—Professor Comstock says of this in the United States Agricultural Report for 1880: "An analysis of it shows that it may be closely copied by dissolving 2 to 2·5 per cent. of green soap in 100 parts of 50 per cent. alcohol." The material is prepared ready for use when purchased, and is sprayed upon the insects with a hand atomizer. It is harmless to the plant, but we have found it rather inferior to the oil and soap washes in its effect upon mealy bug and young scale. When applied, appearances would lead one to think that the destruction of insects was complete, but a later examination will show that quite a share of them recover. The cost is about ninety cents or a dollar a pint.

Hydrocyanic Gas.—At present we cannot recommend its use, except with the greatest caution. One should also remember that it is a strong poison.

Bisulphide of Carbon.—Very good success has been attained in treating red spider and aphis with this gas. Were there not other remedies simpler, cheaper and as effective on these insects, it would no doubt form one of our valuable greenhouse insecticides. As it is, there is too much risk to run from injury to the plants in treating them in this way for the extra benefit derived over tobacco vapor for the aphis, and water or the oil and soap washes for the red spider. To be used on plants they must be placed in a tight box, barrel, or other receptacle. The bisulphide is then introduced in a shallow dish or on cotton batting at the rate of about nine or ten drops per cubic foot of space. Keep the box closed for about two hours.

Flowers of Sulphur.—As a partial insecticide and a good fungicide, sulphur is a desirable substance to use in the greenhouse. It is also destructive to plant life when too much is used, and hence care and experience are needed in its use. Some florists claim good results on red spider from a small quantity of sulphur dropped on a hot shovel and held beneath the mite-infested plant until the odor becomes strong in that vicinity. The usual method is to mix with an equal bulk of air-slaked lime, make it into a thick paste by addition of water, and then spread upon the heating pipes or furnaces.

Lime.—For insects that live in the soil and feed on the roots of plants, alkaline substances, such as air-slaked lime or wood ashes mixed with the soil, give very satisfactory results. They are also considered among the most valuable remedies against eel worms and slugs. Florists differ as to the amount that gives the best results, the range being from a coating an inch thick to a slight white covering of the soil. A conservative average, or less than half an inch coating, would seem nearest right, but this depends greatly upon the depth of the soil on the benches. The lime should be thoroughly mixed with the soil before transplanting to it.

Wood Ashes and Soot.—These substances are good substitutes for air-slaked lime when unleached, but in a fresh state they cannot be used as freely in the soil. Even if they are of no direct benefit in repelling insects, they are of indirect value in supplying potash.

Paris Green.—There are a few insects on house plants against which we can use the arsenites with good effect. Paris green is less apt to injure the foliage than the other arsenites, as there is less soluble arsenic in it. A quarter of an ounce to three gallons of water is as strong as it should be used. If a little strong lime water is added, there will be no danger of injuring tender plants, as all the arsenic in the Paris green then becomes insoluble.

Toads.—The toad is a great insect destroyer and is well worthy the protection of florists. He is actively engaged in catching his prey throughout almost the entire year, and as his work is done mostly at night and on cloudy days, he catches a great many of the night marauders, such as slugs, millipeds, and cutworms. All that he needs is a small pile of loose soil in which to burrow and a cool place under the bench in which to retreat.—Bulletin of Pharmacy.

* Excerpt from Special Bulletin No. 2, Michigan Agricultural College.

Buyers and users of metal roofing and siding have had a tendency toward lighter gages in recent years. This is probably due to the smaller cost and is in line with the general disposition for lower priced goods, even when the difference is very slight. Two gages are now in common use, Nos. 28 and 28, with only infrequent demand for No. 27, but I think that most manufacturers would recommend the use of No. 24 if it were not for the tendency in question. The added cost is not material when the extra weight and wearing qualities are considered. At the same time that lighter gages came in vogue there was noted an increased movement in favor of galvanized sheets and a change from iron to steel, while these are really the most marked changes that have been made in this branch of roofing in the past ten years. Metallic lathing has been introduced in that time, but this is an individual branch of the business and has no direct bearing on the other question.—Stoves and Hardware Reporter.

ELECTRICAL NOTES.

The King of Siam has granted a franchise for an electric lighting plant in Bangkak to an American firm.

The Russian Electro-technical Association will hold an International Electrical Exhibition in St. Petersburg during the summer of 1899. All the principal electro-technical industrial concerns will be invited to participate in the exhibition, for which considerable success is foreshadowed.

Belgrade, the capital of Servia, is now to be supplied with a system of telephone lines. Four hundred customers have already subscribed, and the construction will shortly be taken up by the firm of I. Berliner, of Vienna, who, out of several applicants, have been successful in securing the contract.—Electrotechnische Rundschau.

A Reuter telegram states that during a thunder storm which passed over the district of Rosenheim, Bavaria, recently, a powder factory near Stephanskirchen was struck by lightning. A large quantity of powder, amounting to 11,000 lb., exploded, and 11 houses were shattered. The force of the explosion was such that large trees were torn up by the roots. In Rosenheim, which is about four miles distant from the scene of the explosion, and in Stephanskirchen, which is over a mile off, doors were burst from their hinges and windows from their frames, and in some cases broken. Only one workman at the factory is said to have been injured, and that not seriously.

A large electric installation has recently been completed at Rovos, Norway, says Engineering. There are two large alternate current dynamos, with a tension of 5,000 volts. The dynamos are directly coupled with the turbines, each of 300 horse power. The current is conveyed from the machinery house by means of bright copper wires to three copper mines, some 5 to 7 miles distant, and is there transformed to 150 volts. The electricity is used both for lighting purposes and for working a considerable amount of machinery. A separate dynamo supplies the requisite electricity for the electric railways. Every precaution has been taken to prevent accidents, the wires being protected where the surroundings make this necessary. The height of the fall is about 50 ft.

United States Consul Morris, writing from Ghent, April 16, gives details of the proposed construction of an electric street railway system in that city. The franchise includes all the lines proposed for the entire city, and will be sold to the highest bidder at a fixed annual rental to be paid to the city for a certain term of years, at the expiration of which the city reserves the privilege of purchasing the entire system. The motive power will be electricity, the accumulator to be used in the central portion of the city, and in the outlying districts the trolley system. The fare for first class passengers will be three cents and for second class two cents. The employes will work from thirteen and a half to fourteen and a half hours a day, and the wages for motormen, conductors and workmen are fixed at 72, 69½, and 58 cents per day, respectively. The final award of the franchise will be made on or about July 1.

Capt. Lampe, of the steamship Leon, which arrived at New York City recently with fruit from Jamaican ports, tells a story of a remarkable electric storm encountered while his vessel was off Cape Hatteras. The steamer, according to the skipper's story, was plowing along through a smooth sea, with clear weather overhead, when suddenly, with scarcely any barometric warning, jet black clouds gathered on the horizon, and with almost incredible swiftness mounted into the heavens, accompanied by the constant and terrific booming of thunder and flashes of lightning. The three women passengers on the steamer were almost hysterical from fright. For almost five hours the little vessel groped her way along. All the time the sea was as smooth as glass. The climax of the storm occurred when a great bolt of lightning shot over the bow of the Leon and struck the water fifty yards away with terrific force. An immense volume of water was thrown into the air to a height of fifty feet, deluging the deck of the steamship with spray. Then the rain fell in torrents. The officers of the Leon believe that the water that fell on the vessel was from a cloudburst. The water came, not in drops, but in sheets and columns. The crew were unable to stand the deluge on deck, and all hands were ordered below. Suddenly the clouds lifted, and within a short time there were left the usual summer sky and sea.

A writer in the Iron Age speaks of the trolley as a "dangerous feature for the smaller dealers" in hardware, because it enables the farmer, who was formerly tied down to the general local store, to reach easily the larger centers of trade. "It did not pay the inhabitants of small cities to spend $3 to $4 for the purpose of purchasing about the same amount in a large neighboring city, especially when the number of trains was limited, and when it consumed a whole day and well into the night to make the journey. But now the electric car stops at the farmer's door, suburban cars leave every thirty minutes, they carry express packages, and they take much of the local trade to neighboring cities. The small country dealer is the greatest sufferer. He loses his cash customer and retains those whom he has to carry and who have no ready money. The larger towns gain from the country what trade they lose to the cities, while the cities have nothing to lose." It strikes us from a different point of view. The very fact that the trolley cars deliver express packages should enable the small general store in a village to carry practically a much larger stock than ever before and to fill many wants that previously were not felt or went unsatisfied because of the distance from market. Besides, accessibility always promotes trade and intercourse, and this ought to be a good thing for the small country dealer, particularly if the trolley brings into his neighborhood a number of residents, earning good weekly cash salaries, to whom the real country was formerly out of reach. Heretofore the small dealer has presumed on his inaccessibility, and made it an excuse for not handling a number of useful and desirable things. The trolley gives him a genuine opportunity of new life. But if he supinely lies down to die, he will die before he is dead, and someone else will see the modern chances and find a profitable way out.

MISCELLANEOUS NOTES.

The United States of Brazil issued 200 patents in 1896, of which 111 were secured by Brazilians, 22 by Americans, the same number by Englishmen, 16 by Frenchmen, and 14 by Germans.—La Propriété Industrielle.

Mulhausen (Alsace) shows a remarkable increase in population; in the 20 years from 1875–1895, the number of inhabitants has risen from 58,463 to 83,040, i. e., 42 per cent. This is mainly due to the growth of the manufactures, and a correspondingly increased demand for workmen.—Uhland's Wochenschrift.

Mr. Venukoff informs the Geographic Society of Paris that the Araxes (Transcaucasia), restored to its ancient course, now flows directly into the Caspian Sea, and is thus no longer a tributary of the Kura. As this change is considered favorable by the inhabitants, the government has been requested to take measures to render the present state of things permanent.—Die Umschau.

Hitherto calcium carbide was prepared by fusing lime and coke together in a Moissan and Willson electric furnace. But this process, even if the required force can be supplied by a watercourse, is rather costly, so that a cheaper process, patented by Pictet, is likely to prove very useful. He introduces the lime and coke in a furnace and acts with the electric arc at the bottom only. The coke begins to burn, and, by the aid of a blast of hot air, raises the whole mass to a very high temperature, so that but little additional heating on the part of the arc is required. This improvement is of great importance, because it will make acetylene a dangerous rival to our ordinary coal gas, which it far exceeds in luminosity.—Electrotechnische Rundschau.

A patent has been applied for in Belgium for an incombustible lampwick. This is made of glass, and it is traversed by fine channels. The lamp is lit automatically, the oil being drawn up the channels by atmospheric pressure. It is urged as one of the main advantages of the invention, besides the incombustibility of the burner, that the supply of oil is uniform, so that a flickering flame and the result of such, the cracking of chimneys, are avoided. It seems, however, that on the one hand the making of such wicks offers difficulties, and on the other even refined kerosene oil leaves solid residues which would in time stop up the pores, and danger of explosion would arise.—Uhland's Wochenschrift.

We give a description of a new procedure for condensing milk into a semi solid or a powder.

The milk is first frozen, being continually kept in motion, so that the ice crystals may separate out. By means of a centrifugal separator the milk is then obtained free from ice. This process is repeated until the product contains 80–85 per cent. solid constituents. The milk is then sterilized and concentrated in vacuo at a temperature of 38° Centigrade. Into the vacuum carbon dioxide is admitted, and the pasty mass is cast into forms. When solid it is hacked up, finally dried in carbon dioxide, cooled to 0° Centigrade, and powdered. The powder is packed in hermetically sealed jars which contain carbon dioxide.—Uhland's Wochenschrift.

An immense block of granite, having a given weight of not less than 1,217 tons, was recently put in place at St. Petersburg as the pedestal for the new statue of Peter the Great, the block having been transported four miles by land over a railway and thirteen miles in a caisson by water. The railway consisted of two lines of timber furnished with hard metal grooves, between which grooves were placed spheres of hard brass about six inches in diameter; on these spheres the frame with its load was easily moved by a force of sixty men working at the capstans with treble purchase blocks. Another large block, measuring thirty-five by sixteen by fourteen feet, is reported to have been taken out, a few months since, from the Craigneth quarries, near Dalbeattie, Scotland, the block weighing 650 tons.

Wm. W. Astor entertained his guests at a dinner in London, England, not long ago, with stories of the big trees in California. Some of his hearers professed to be skeptical, whereat Mr. Astor offered to wager that he could have prepared from one cross section of a California tree a table sufficiently large to accommodate at dinner the forty guests then assembled, or others to that number. The wager was accepted. The sequel is transpiring. There was shipped at San Francisco recently a redwood section, cut from a tree 14 ft. 4 in. in diameter, consigned to "W. W. Astor, London, England." The piece of timber is 8 ft. thick and weighs 19 tons. Given time, and safe voyage to the good ship, Mr. Astor will entertain forty or more guests around a table constructed of this product of the forests of Humboldt County, Cal., and win his wager, at the same time impressing an object lesson on his insular cousins to the glorification of the United States.

A demonstration of the fire resisting properties of timber, prepared in accordance with a process recently patented in America, has been given in England. Two small houses, each of identical shape and dimensions, and fitted with wooden chimneys, but constructed in the one case of ordinary and in the other of treated timber, were exposed to the flames of a large bonfire piled against the windward side of each of the two buildings. The first named caught fire immediately, and collapsed in the course of half an hour, while the other stood the ordeal almost unharmed. Finally, a second fire was lighted inside this building, the chimney of which created a fierce draught. The structure, however, remained quite intact, and the wood, though it charred somewhat, entirely refused to burst into flame. The treatment consists in first thoroughly desiccating the timber in vacuo and then impregnating it under pressure with certain salts, the nature of which was not disclosed. The appearance of the timber and its working qualities are scarcely affected. In fact, it takes a polish somewhat more readily after treatment than before, as the pores of the timber are filled in the process. The battle of Yalu showed the importance of abolishing inflammable material on board warships, while the comfort of the officers and crew are equally bound up in the maintenance of a wood finish for their quarters. If the expense of the process does not prove prohibitive, a fairly large field should, we think, be open to it in this direction, and we note that it has been adopted somewhat extensively by the government of the United States.

SELECTED FORMULÆ.

The Preservation of Animals.—In a recent number of Natural Science there is given a summary of the observations of Mr. Amyrald Haly, director of the museum of Colombo, upon the value of formaline as an agent for preserving zoological specimens. According to Mr. Haly, who has been using this material for the last two years, a 1½ or 2 per cent. solution suffices to preserve the invertebrates in general. For the vertebrates it requires a 3 or 3½ per cent. solution. Formaline preserves the Medusæ admirably, their colors and transparency remaining unchanged. Mr. Haly confesses, however, that formaline is not of universal application, for sometimes it fails. For fish of bright colors it is better to use gum and glycerine, and the same is the case with crustacea; but perhaps gum and formaline mixed might be used with advantage.

Cleansing Fluid for Aluminum Ware.—A solution of 30 grammes of borax in 1 liter of water containing a few drops of aqua ammonia.

Varnish for Aluminum Bronze.—The liquid which is sold in the United States under the trade name of the light Japan gold size is the best varnish to use with powdered aluminum bronze. This, however, is not the same article as is sold in England under the name of the gold size, and the best of these varnishes is made by taking 50 pounds of Kauri and 50 pounds of Zanzibar resin, together with 5 gallons of refined linseed oil, cooking these at a high temperature until there is no free oil left. This mixture should then be thinned down with a proper amount of turpentine (about 25 or 30 gallons), and then a drier should be added.—Aluminum World.

Preserving Tomatoes.—Take the best, firmest, and not over-ripe fruits, scald and skin carefully, take the stem out with a penknife, being careful not to cut the tomato and let the juice out; place in a jar, some with the stem and some with the flower end next to the glass. Cook some juice, adding a little salt, and pour over the whole tomatoes until the jar is nearly full. Place the jars in a common fish boiler of oblong shape, with a cloth at the bottom to protect them from the heat of the fire, which is liable to crack them. Fill the boiler with cold water and bring to nearly boiling point, or sufficient to heat the tomatoes clear through, and seal the jars. In about five minutes take off the jar cover to let gas out and allow the tomatoes to settle; then fill up with boiled juice and seal again. Next day screw the tops tight and put away in a dark, cool place.—Agricult. Journ., x, 330.

Insecticide for Plant Lice.—An effective insecticide for various insect pests on greenhouse plants is composed of the following:

Take of

Methylated spirit	200	parts.
Soft soap	20	"
Quassia wood	6	"
Salicylic acid	2½	"

Macerate for several days; dilute with sufficient water, and apply to the infested parts by means of a brush. Allow to dry on; the following day wash off with plenty of water.—Rev. Méd. Pharm.

Antiseptic Mouth Wash.—The Presse Médicale contains the following formula:

Thymol	4	gr.
Benzoic acid	14	"
Tincture of eucalyptus	225	"
Essence of peppermint	9	"
Chloroform	15	"
Alcohol	3	"

M. Twenty drops of this solution in a glass of water may be used at a time.

Mothol.—A pleasant deodorizer and moth preventive.

Alcohol	40	oz.
Tincture of capsicum	5	"
Naphthalene	1	"
Absolute phenol	1	"
Menthol	⅛	"
Oil of lemongrass	⅛	"

Mix and filter. To be used in the form of spray by means of an atomizer where the moths frequent.—Bulletin of Pharmacy.

Photographic Hints and Formulas.—

From Liesegang's Photographischer Almanach.—(Amer. Photo. Jl.)

Chalk Bath.—

Water	100 c. cm.
Chloro-aurate of potassium	1 grm.

For use—

Above solution	10 c. cm.
Water	115 "
Whitening	1 grm.

Mix and shake thoroughly at least twelve hours before use.

Toning Bath (Acetate of Soda).—

Water	2 liters.
Chloride of gold	1 grm.
Acetate of soda	30 "

Crystallized acetate of soda gives warm red tones; fused, bluish tones. The latter bath must be made up twenty-four hours before use.

Toning Bath (Borax).—

Water	1 liter.
Borax (fused)	8 grm.
Chloride of gold	1 "

Toning Bath (Chloride of Lime).—

Acetate of potassium	12 grm.
Chloride of lime	3 "
Carbonate of potash	6 "
Distilled or boiled water	480 c. cm.

Above is to be well shaken, then allowed to settle, decanted and filtered through cotton.

For use—

Above stock solution	320 c. cm.
Distilled or boiled water	3 liters.
Chloride of gold	1 grm.

This bath keeps well and may be used until the gold is entirely exhausted. Prints should be printed up strong.

SIGNALING THROUGH SPACE WITHOUT WIRES.*

By W. H. PREECE, C.B., F.R.S.

SCIENCE has conferred one great benefit on mankind. It has supplied us with a new sense. We can now see the invisible, hear the inaudible, and feel the intangible. We know that the universe is filled with a homogeneous continuous elastic medium which transmits heat, light, electricity, and other forms of energy from one point of space to another without loss. The discovery of the real existence of this "ether" is one of the great scientific events of the Victorian era. Its character and mechanism are not yet known by us. All attempts to "invent" a perfect ether have proved beyond the mental power of the highest intellects. We can only say with Lord Salisbury that the ether is the nominative case to the verb "to undulate." We must be content with a knowledge of the fact that it was created in the beginning for the transmission of energy in all its forms, that it transmits these energies in definite ways and with a known velocity, that it is perfect of its kind, but that it still remains as inscrutable as gravity or life itself.

Any disturbance of the ether must originate with some disturbance of matter. An explosion, cyclone or vibratory motion may occur in the photosphere of the sun. A disturbance or wave is impressed on the ether. It is propagated in straight lines through space. It falls on Jupiter, Venus, the earth, and every other planet met with in its course, and any machine, human or mechanical, capable of responding to its undulations indicates its presence. Thus the eye supplies the sensation of light, the skin is sensitive to heat, the galvanometer indicates electricity, the magnetometer shows disturbances in the earth's magnetic field. One of the greatest scientific achievements of our generation is the magnificent generalization of Clerk-Maxwell that all these disturbances are of precisely the same kind, and that they differ only in degree. Light is an electromagnetic phenomenon, and electricity in its progress through space follows the laws of optics. Hertz proved this experimentally, and few of us who heard it will forget the admirable lecture on "The Work of Hertz" given in this hall by Prof. Oliver Lodge three years ago.

By the kindness of Prof. Silvanus Thompson I am able to illustrate wave transmission by a very beautiful apparatus devised by him. At one end we have the transmitter or oscillator, which is a heavy suspended mass to which a blow or impulse is given, and which, in consequence, vibrates a given number of times per minute. At the other end is the receiver, or resonator, timed to vibrate to the same period. Connecting the two together is a row of leaden balls suspended so that each ball gives a portion of its energy at each oscillation to the next in the series. Each ball vibrates at right angles to or athwart the line of propagation of the wave, and as they vibrate in different phases you will see that a wave is transmitted from the transmitter to the receiver. The receiver takes up these vibrations and responds in sympathy with the transmitter. Here we have a visible illustration of that which is absolutely invisible. The wave you see differs from a wave of light or of electricity only in its length or in its frequency. Electric waves vary from units per second in long submarine cables to millions per second when excited by Hertz's method. Light waves vary per second between 400,000,000,000 in the red to 800,000,000,000 in the violet, and electric waves differ from them in no other respect. They are reflected, refracted, and polarized, they are subject to interference, and they move through the ether in straight lines with the same velocity, viz., 186,400 miles per second—a number easily recalled when we remember that it was in the year 1864 that Maxwell made his famous discovery of the identity of light and electric waves.

Electric waves, however, differ from light waves in this, that we have also to regard the direction at right angles to the line of propagation of the wave. The model gives an illustration of that which happens along a line of electric force; the other line of motion I speak of is a circle around the point of disturbance, and these are called lines of magnetic force. The natural eye is tuned to one series of waves, the "electric eye," as Lord Kelvin called Hertz's resonator, to another. If electric waves could be reduced in length to the forty-thousandth of an inch, we should see them as colors.

One more definition and our ground is cleared. When electricity is found stored up in a potential state in the molecules of a dielectric like air, glass or gutta percha, the molecules are strained, it is called a charge, and it establishes in its neighborhood an electric field. When it is active or in its kinetic state in a circuit, it is called a current. It is found in both states, kinetic and potential, when a current is maintained in a conductor. The surrounding neighborhood is then found in a state of stress, forming what is called a magnetic field.

In the first case the charges can be made to rise and fall and to surge to and fro with rhythmic regularity, exciting electric waves along each line of electric force, at very high frequencies, and in the second case the currents can rise or alternate in direction with the same regularity, but with very different frequency, and originate electromagnetic waves whose wave fronts are propagated in the same direction.

The first is the method of Hertz, which has recently been turned to practical account by Mr. Marconi, and the second is the method which I have been applying, and which, for historical reasons, I will describe to you first.

In 1884 messages sent through insulated wires buried in iron pipes in the streets of London were read upon telephone circuits, erected on poles above the housetops 80 feet away. Ordinary telegraph circuits were found in 1885 to produce disturbances 2,000 feet away. Distinct speech by telephone was carried on through one-quarter of a mile, a distance that was increased to 1½ miles at a later date. Careful experiments were made in 1886 and 1887 to prove that these effects were due to pure electromagnetic waves and were entirely free from any earth conduction. In 1892 distinct messages were sent across a portion of the Bristol Channel, between Penarth and Flat Holm, a distance of 3·3 miles.

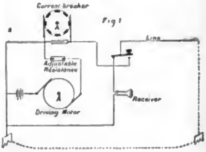
Early in 1895 the cable between Oban and the Isle of Mull broke down, and as no ship was available for repairing and restoring communication, communication was established by utilizing parallel wires on each side of the channel and transmitting signals across this space by these electromagnetic waves.

The apparatus (Fig. 1) connected to each wire consists of: (a) A rheotome or make and break wheel, causing about 260 undulations per second in the primary wire. (b) An ordinary battery of about 100 Leclanche cells, of the so-called dry and portable form. (c) A Morse telegraph key. (d) A telephone to act as receiver. (e) A switch to start and stop the rheotome. Good signals depend more on the rapid rise and fall of the primary current than on the amount of energy thrown into vibration. 260 vibrations per second give a pleasant note to the ear, easily read when broken up by the key into dots and dashes.

In my electromagnetic system two parallel circuits are established, one on each side of a channel or bank of a river, each circuit becoming successively the primary and secondary of an induction system, according to the direction in which the signals are being sent. Strong alternating or vibrating currents of electricity are transmitted in the first circuit so as to form signals, letters, and words in Morse characters. The effects of the rise and fall of these currents are transmitted as electromagnet waves through the intervening space, and if the secondary circuit is so situated as to be washed by these ethereal waves, their energy is transformed into secondary currents in the second circuit, which can be made to affect a telephone, and thus to reproduce the signals. Of course their intensity is much reduced, but still their presence has been detected, though five miles of clear space have separated the two circuits.

Such effects have been known scientifically in the laboratory since the days of Faraday and of Henry, but it is only within the last few years that I have been able to utilize them practically through considerable distances. This has been rendered possible through the introduction of the telephone.

Last year—August, 1896—an effort was made to establish communication with the North Sandhead (Goodwin) Lightship. The apparatus used was manufactured by Messrs. Evershed & Vignoles, and a most ingenious relay to establish a call was invented by Mr. Evershed. One extremity of the cable was coiled in a ring on the bottom of the sea, embracing the whole area over which the lightship swept while swinging to the tide, and the other end was connected with the shore. The ship was surrounded above the water line with another coil. The two coils were separated by a mean distance of about 200 fathoms, but communication was found to be impracticable. The screening effect of the sea water and the effect of the iron hull of the ship absorbed practically all the energy of the currents in the coiled cable, and the effects on board, though perceptible, were very trifling—too minute for signaling. Previous experiments had failed to show the extremely rapid rate at which energy is absorbed with the depth or thickness of sea water. The energy is absorbed in forming eddy currents. Although this experiment has failed through water, it is thoroughly practical through air to considerable distances, where it is possible to insert wires of similar length on each side of the distance to be crossed. It is not always possible, however, to do this, nor to get the requisite height to secure the best effect. It is impossible on a lightship, and on rock lighthouses. There are many small islands—Sark, for example—where it cannot be done.



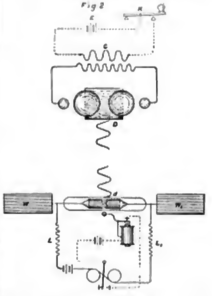
In July last Mr. Marconi brought to England a new plan. My plan is based entirely on utilizing electromagnetic waves of very low frequency. It depends essentially on the rise and fall of currents in the primary wire. Mr. Marconi utilizes electric or Hertzian waves of very high frequency, and they depend upon the rise and fall of electric force in a sphere or spheres. He has invented a new relay which, for sensitiveness and delicacy, exceeds all known electrical apparatus.

The peculiarity of Mr. Marconi's system is that, apart from the ordinary connecting wires of the apparatus, conductors of very moderate length only are needed, and even these can be dispensed with if reflectors are used.

The Transmitter.—His transmitter is Prof. Righi's form of Hertz's radiator—see Fig. 2. Two spheres of solid brass, 4 in. in diameter—A and B—are fixed in an oil tight case of insulating material, so that a hemisphere of each is exposed, the other hemisphere being immersed in a bath of vaseline oil. The use of oil has several advantages. It maintains the surfaces of the spheres electrically clean, avoiding the frequent polishing required by Hertz's exposed balls. It impresses on the waves excited by these spheres a uniform and constant form. It tends to reduce the wave lengths—Righi's waves are measured in centimeters, while Hertz's were measured in meters. For these reasons the distance at which effects are produced is increased. Mr. Marconi uses generally waves of about 120 centimeters long. Two small spheres, a and b, are fixed close to the large spheres and connected each to one end of the secondary circuit of the "induction coil," C, the primary circuit of which is excited by a battery, E, thrown in and out of circuit by the Morse key, K. Now, whenever the key, K, is depressed sparks pass between 1, 2 and 3, and since the system, A B, contains capacity and electric inertia, oscillations are set up in it of extreme rapidity. The line of propagation is Dd, —Fig. 2—and the frequency of oscillation is probably

WILLIAM MARCONI, INVENTOR OF THE APPARATUS FOR TELEGRAPHING WITHOUT WIRES.

Fig 2

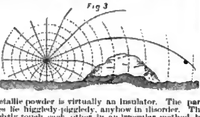


* Friday evening discourse delivered before the Royal Institution, June 4, 1897. We are indebted to London Engineer and L'Illustration for the engravings published herewith.

about 230 millions per second. The distance at which effects are produced with such rapid oscillations depends chiefly on the energy in the discharge that passes. A 6 in. spark coil has sufficed through 1, 2, 3, up to four miles, but for greater distances we have used a more powerful coil—one emitting sparks 20 in. long. It may also be pointed out that the distance increases with the diameter of the spheres, A and B, and it is nearly doubled by making the sphere solid instead of hollow.

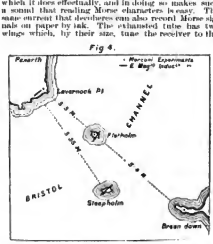
The Receiver.—Marconi's relay—see Fig. 2—consists of a small glass tube four centimeters long, into which two silver pole pieces are tightly fitted, separated from each other by about half a millimeter—a thin space which is filled up by a mixture of fine nickel and silver filings, mixed with a trace of mercury. The tube is exhausted to a vacuum of four millimeters and sealed. It forms part of a circuit containing a local cell and a sensitive telegraph relay. In its normal condition the

Fig 3



metallic powder is virtually an insulator. The particles lie higgledy-piggledy, anyhow in disorder. They lightly touch each other in an irregular method, but when electric waves fall upon them they are "polarized," order is installed. They are marshaled in serried ranks, they are subject to pressure; in fact, as Prof. Oliver Lodge expresses it, they "cohere"—electrical contact ensues, and a current passes. The electric resistance of Marconi's relay—that is, the resistance of the thin disk of loose powder—is practically infinite when it is in its normal or disordered condition. It is then, in fact, an insulator. This resistance drops sometimes to 5 ohms, when the absorption of the electric waves by it is intense. It therefore becomes a conductor. It may be that we have in the measurement of the variable resistance of this instrument a means of determining the intensity of the energy falling upon it. This variation is being investigated, both as regards the magnitude of the energy and the frequency of the incident waves. Now such electrical effects are well known. In 1866 Mr. S. A. Varley introduced a lightning protector constructed like the above tube, but made of boxwood and containing powdered carbon. It was fixed at a shunt to the instrument to be protected. It acted well, but was subject to this coherence, which rendered the cure more troublesome than the disease, and its use had to be abandoned. The same action is very common in granulated carbon microphones like Hunning's, and shaking has to be resorted to to decohere the carbon particles to their normal state. Mons. E. Branly—1890—showed that copper, aluminum, and iron filings behaved in the same way. Prof. Oliver Lodge, who has done more than any one else in England to illustrate and popularize the work of Hertz and his followers, has given the name "coherer" to this form of apparatus. He has much improved it. Marconi "decoheres" by making the local current very rapidly vibrate a small hammer head against the glass tube, which it does effectually, and in doing so makes such a sound that reading Morse characters is easy. The same current that decoheres can also record Morse signals on paper by ink. The exhausted tube has two wings which, by their size, tune the receiver to the

Fig 4.



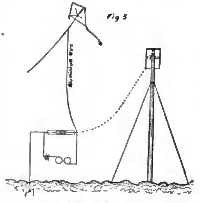
transmitter. Choking coils prevent the energy escaping. The analogy to Prof. Silvanus Thompson's wave apparatus is evident. Oscillations set up in the transmitter fall upon the receiver tuned in sympathy with it, coherence follows, currents are excited, and signals made.

In open clear spaces within sight of each other nothing more is wanted, but when obstacles intervene and great distances are in question, height is needed, tall masts, kites and balloons have been used. Excellent signals have been transmitted between Penarth and Brean Down, near Weston-super-Mare, across the Bristol Channel, a distance of nearly nine miles—Fig. 4. I must now show the system in operation. Mirrors also assist and intensify the effects. They were used in the earlier experiments, but they have been laid aside for the present, for they are not only expensive to make, but they occupy much time in manufacture.

It is curious that hills and apparent obstructions fail to obstruct. The reason is probably the fact that the lines of force escape these hills. When the ether is entangled in matter of different degrees of inductivity the lines are curved as, in fact, they are in light. Fig. 3 shows how a hill is virtually bridged over by these lines, and consequently some electric waves fall on the relay. Weather seems to have no influence; rain, fogs, snow, and wind avail nothing. The wings shown in Fig. 2 may be removed. One pole can be connected with earth, and the other extended up to the top of the mast, or fastened to a balloon by means of a wire. The wire and balloon covered with tin foil or kite becomes the wing. In this case one pole of the transmitter must also be connected with earth. This is shown by Fig. 5. There are some apparent anomalies that have developed themselves during the experiments. Mr. Marconi finds that his relay acts even when it is placed in a perfectly closed metallic box. This is the fact that has given rise to the rumor that he can blow up an ironclad ship. This might be true if he could plant his properly tuned receiver in the magazine of an enemy's ship. Many other funny things could be done if this were possible. I remember in my childhood that Capt. Warner blew up a ship at a great distance off Brighton. How this was done was never known, for his secret died shortly afterward with him. It certainly was not by means of Marconi's relay.

The distance to which signals have been sent is remarkable. On Salisbury Plain Mr. Marconi covered a distance of four miles. In the Bristol Channel this has been extended to over eight miles, and we have by no means reached the limit. It is interesting to read the surmises of others. Half a mile was the wildest dream.* It is easy to transmit many messages in any direction at the same time. It is only necessary to tune the transmitters and receivers to the same frequency or "note." I could show this here, but we are bothered by reflection from the walls. This does not happen in open space. There are a great many practical points connected with this system that require to be thrashed out in a practical manner before it can be placed on the

Fig 5



market, but enough has been done to prove its value and to show that for shipping and lighthouse purposes it will be a great and valuable acquisition.

* "Unfortunately, at present we cannot detect the electro-magnetic waves more than 100 ft. from their source."—Trowbridge, 1897, "What is Electricity?" page [illegible].

"I mention forty yards, because that was one of the first out-of-door experiments, but I should think that something more like half a mile was nearer the limit of sensibility. However, this is a rash statement, and at present verified."—Oliver Lodge, 1894, "The Work of Hertz," page 18.

PRACTICAL THOUGHTS ON DIET.

By J. HOBART EGBERT, A.M., M.D., Ph.D.

THE love of personal liberty, so patent in the human family, has long been a subject of comment, not only for philosophers, but for physiologists as well. To what extent one's desires may be accepted as proper guides in life is a question which constantly engages the attention of all those who labor for the promotion of public, as well as individual, welfare. Not a few—prominent among whom will be found the naturally strong and robust and the disheartened and desperate—are wont to disregard the higher organization of man—his vast personal liberty, bounded only by conscious reason—and to advocate that man's native tendencies will, like the unerring instinct of animals, direct him aright. Thus, Montesquieu expressed the sentiment of the multitude when he stated that the health purchased by a rigorous watching of the diet is but a tedious disease. But this belief, voiced by Montesquieu and reiterated by the liberty-loving masses, embodies a fallacy of no small magnitude or mean importance. When we consider the vast and direct influence of diet upon all the functions of life, when we reflect that man's education and not an inborn instinct directs him in the selection and proper use of food, and observe how invariably the penalty of abuse and transgression here, as elsewhere, sooner or later falls upon those who disregard the laws of Nature, we are led to know that to apply to diet—as to other habits of life—the principles of physiology and those allied sciences which reveal to us the laws governing the phenomena of Nature, is not to forfeit but to confirm, and by understanding their conditions to enlarge our liberty.

To those who would have as their only guide in dietetics a vigorous, and, doubtlessly perverted, appetite, we submit for careful consideration the following lines from the pen of England's profound physiologist and celebrated surgeon, Sir Henry Thompson. In a contribution to the Nineteenth Century this astute observer writes: "I have for some years past been compelled, by facts which are constantly coming before me, to accept the conclusion that more mischief in the form of actual disease, of impaired vigor, and of shortened life, accrues to civilized man, so far as I have observed in our own country and throughout Western and Central Europe, from erroneous habits in eating than from the habitual use of alcoholic drink, considerable as I know the evil of that to be. . . . I have come to the conclusion that a proportion amounting at least to more than one-half of the disease which embitters the middle and latter part of life among the middle and upper classes of the population is due to avoidable errors in diet. Further, while such disease renders so much of life for many disappointing, unhappy, and profitless, a term of painful endurance, for not a few it shortens life considerably."

The fact that many of the dietetic laws laid down by scientists have, when applied in actual life, been shown to be inadequate, is a stumbling block to many. The reason for this is not difficult of explanation, nor does it in any way lessen the value of the truth. In attempting to lay down hard and fast dietetic laws, pseudoscience has certainly evinced its incompetence by presuming to dictate laws to Nature rather than to expound existing truths; by confounding chemical with vital processes, and by disregarding the variations of force, organic strength, and particular requirements existing in different individuals and in the same individual under varying conditions of health, occupation, and environment. True science cannot be credited with such errors, for while its votaries may grossly err in their enunciations, the fundamental truths remain unchanged. Thus, through the pedantry of those who presume to interpret Nature's laws and formulate working codes applicable to life, the evils of ignorance and indiscretion are often thrust aside only to give place to the leaden tyranny of routine. What folly, as Herbert Spencer has observed, to suppose that the whole of dietetics lies in determining whether or not bread is more nutritive than potatoes, or in similar arguments. The physiologist of to-day is far wiser than the physiologist of yesterday, in that he recognizes in human intelligence a voice which speaks from within, and which evinces in mankind as in animals natural desires which require the cultivation and rational direction of education, rather than their overthrow and the substitution of purely artificial systems and habits of life.

Man's dietetic education begins in early childhood and continues throughout life. Some never receive other education in this direction than the example of others, while some, unsatisfied with strict adherence to an established precedent, by investigation, speculation and study enlarge the boundaries of their knowledge. Charles Lamb's "Dissertation on Roast Pig" fitly illustrates this theme and also points to the existence of what it now behooves us to consider more directly—to wit, a useful and natural appetite. To utterly ignore natural desires and maintain that judgment and education alone lead to the use of food suitable for the sustenance of the body would be to turn to the other and more irrational extreme. Charles Lamb's hero, in licking his burnt fingers—injured by handling the charred and heated remains of the litter—stirred up a latent appetite for roast pig and at once set about to appease it by devouring the still smoking carcass; and the train of incidents which followed the discovery of his violation of established rules show how, by a simple chain of natural circumstances, a rigid dogma may be overthrown. Yet who will argue that too much pork is not frequently eaten by many, or deny that educational training in things dietetic has not a direct influence upon the health and longevity of the Jewish people?

While there is a general correspondence in the kinds of food which the various members of the human family enjoy, there may also be observed in individuals a special inclination for certain articles of diet and a marked antipathy for others. Thus it is found that, to a normal appetite, distaste for any special article of food is often indicative of its inadaptation to the needs of that particular individual, while the craving for some questionable article of diet may be indicative of its value as a nutriment to the individual under the existing circumstances. In a word, appetite for food is often not only the expression of desire but of fitness as well. But, alas! it is not an invariable and unfailing guide to felicity. Does not the earliest record of human affairs contain an intimation of the perverseness of man's appetite—and that of woman as well—in the command to Adam: "But of the tree of the knowledge of good and evil thou shalt not eat of it; for in the day that thou eatest thereof thou shalt surely die." Nor does science give a perfect rule applicable to each and every case—for experience, and not theory, may alone reveal the truth. Not until we shall have gained a more definite knowledge of that subtile force which we term vitality—that force in virtue of which we exist—shall we be able to restrict with exact limitations the natural tendencies of erring man.

Admitting the function of our natural inclinations in respect to food, and granting that they indicate the existence of important relations between ourselves and our environment, which are revealed to us in no other way, it is not yet demonstrated that they are unerring guides in human life. It is physiologically shown, as well as philosophically emphasized, that with man the natural tendency of all carnal desires is to excess, and hence we can concede the fundamental government of nutrition to appetite only when appetite leads to the fulfilling of instinctive impulses by the legitimate and rational gratification of natural desires. In a word, man is called upon to employ both reason and knowledge in aiding and controlling his natural desires.

To be guided by nature implies not only that we must have natural tastes to gratify, but also that they are given due opportunity to indicate their normal preferences. By the habitual use of strongly seasoned dishes, of artificial flavors, of modes of cooking which conceal the natural taste of the substance, and even of a great variety of dishes at a meal, the appetite is daily perverted. The chief aim seems to be to please the palate rather than to satisfy the wholesome hunger of the stomach. It is true that the enjoyment of food exerts an influence in promoting the activity of digestive processes, but the relish must be real and not imaginary—general, not merely local—for the best diet gives not only temporary, but permanent and genuine satisfaction. "It is more than probable," says Dr. Hinton, "that some men lead languid and unenjoyable lives in the midst of every advantage, chiefly for want of some little article of food which nature needs, and which under a simpler regimen their tastes would decisively demand." Nor is this an extravagant idea, for there is ample proof that the importance of special portions of our food cannot be estimated merely by the value of their direct contribution to the system. The yeast is small in quantity, but it is all-important to the loaf. And there is every reason to believe that certain portions of our food act a part which may be compared to that of yeast in respect to bread. Nutrition is by no means a simple transference of so much matter into the body, but a long series of changes, in which certain elements are subservient to others. The repair of the

substance of the body by one part of the food is dependent upon forces derived from the changes which other parts undergo. No mere quantity, though ample, and every portion unexceptionable in its way, will give the true result, unless there is also present the complementary substance in due proportion to supply the needful stimulus.

To those who maintain a certain simplicity of living, who avoid the use of stimulants and narcotics, and obey the laws of health regarding exercise, fresh air, sleep, cleanliness, and general habit, great license may be allowed in matters of diet. But do such persons constitute the masses? Again, no matter how healthy a child, or how physically strong a man he may be, we know that they are incompetent to select proper food for the nourishment of their bodies. Does this emphasize the value of instinct or of reason and education?

One thought in conclusion. What effect did a knowledge of the methods and habits of civilized men have upon the North American Indians? They easily learned the vices and excesses of civilization without comprehending the laws necessary to the maintenance not only of that civilization but of life itself under the artificial conditions which it produces, and the result is, or at least soon will be, seen in the extinction of the race.—Dietetic and Hygienic Gazette.

APPARATUS FOR ROENTGEN WORK.*

OWING to the interest aroused by Prof. Roentgen's discovery, a few words on the construction of induction coils and other pieces of apparatus in connection with the production of the X rays may not be out of place. Any person with an ordinary amount of ingenuity and some little mechanical skill can make the apparatus mentioned below, and much cheaper than it can be bought.

The first and perhaps most important point is the generation of the necessary power requisite to run the coil; this can be obtained from primary batteries, secondary batteries or accumulators, and the ordinary supply mains. Of primary batteries the most powerful is the bichromate, composed of a plate of zinc and two plates of carbon in a saturated solution of bichromate, to which is added strong sulphuric acid. This, unfortunately, has the disadvantage of falling off in strength after some time. Daniell's cell, composed of a cylinder of copper surrounded by copper sulphate, and a zinc plate in a porous pot and surrounded by zinc sulphate, is more constant, but not so powerful. Secondary batteries have the disadvantage of having to be recharged, and this can only be done at a dynamo or off the supply mains; otherwise this is a very convenient and portable form for producing the current. These must be bought, as the manufacture is of great difficulty and involves the use of large currents in the formation of the plates. The coil can also be driven off the supply mains, great care being taken to have sufficient resistance in circuit to prevent too large a current flowing through the primary and fusing the wire, and may be, the leads of the house. An alternating current can be used and slightly simplifies the construction of the coil, but an ordinary resistance cannot be used in this case. It has been shown that these results can be produced with short exposures by a coil giving a spark of about 6 inches, and the production of this I propose to describe.

The coil, as represented in Fig. 1, is composed of a bundle of iron wire, surrounded by two layers of

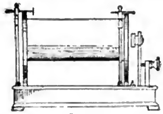


FIG. 1.

thicker wire, called the primary, which carries the inducing current; and this is again surrounded by a large number of coils of very thin wire, called the secondary, in which the high pressure is produced; a contact breaker, and a condenser. The iron core is composed of well annealed iron wire, of No. 30 B. W. G. (Birmingham wire gauge), 28 Am. W. G., made into a bundle 14½ inches by 1½ inches, made red hot in a fire and allowed to cool slowly. When cold, the whole bundle, kept together by wires round the outside, is soaked in shellac varnish or melted paraffin wax until it has penetrated right through. This is to prevent destructive currents being set up in the iron. When dry a layer of brown paper, soaked in paraffin wax, is placed round; and over the whole a thin ebonite tube. On this is wound the primary wire, composed of two layers of No. 14 B. W. G. (12 Am. W. G.) cotton covered and well soaked in paraffin wax. About two pounds of wire will be required. A layer is wound on, leaving ends long enough for making the connections, and over this a layer of paraffined brown paper, then the other layer of wire, finishing at the end at which the winding started. The primary wire will safely carry eight amperes without heating appreciably, and very likely ten could be used. Over the last layer is placed a layer of paraffined paper, and then a thin ebonite tube. On this is wound the secondary coil, which is best composed in sections—in this coil, eight. This arrangement, by placing wires having a great difference of potential away from one another, much diminishes the chance of internal sparking and thus ruining the coil. The wire is No. 36 B. W. G., 38 Am. W. G., of which twelve pounds will be required, silk covered, and the bobbins containing the wire should be soaked in paraffin wax before winding. A pound and a half of wire is wound upon each section, a former being made corresponding to a section and having one side removable, and may be driven from an ordinary sewing machine table. Fig. 2 will show the method of winding.

* By E. A. Holmes, in the Photogram.

The wire is drawn through a hole near the lower part of the former, leaving enough projecting for connections, and the bobbin filled with wire, 1½ pounds. The next is wound in the same way, and the coil turned round before placing upon the core, thus, in two adjacent sections the wires run in opposite directions, as will be seen from Fig. 2; the two inner ends are

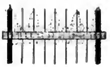


FIG. 2.

connected. The third coil is wound and placed like the first, the outer end being joined over the top of the division, with the outer end of the second coil. The fourth is like the second, and has its inner end joined to the inner end of the third, and so on, the eighth coil having one end free and is one of the terminals, the first coil being the other. The coils should be soaked in paraffin wax; the divisions may be thin ebonite of one-sixteenth to one-eighth inch thick, or of two or three thicknesses of celluloid, such as is used for the thick films, which I find very useful for this purpose. The ends may be made of ebonite or well seasoned mahogany about ⅜ inch thick. Of course there is no connection between the primary and secondary. If there is, the coil is of absolutely no use. The soldering of joints between the coils should preferably be done with resin, as "killed" acid may corrode the wire and cause heating, and perhaps melting of the wire. The outside should be covered with thin sheet ebonite bent round. This prevents sparking on to the coil. The secondary terminals should be supported, about eight inches apart, on glass rods. The coil, if it is to be used with continuous currents, must have some method of making and breaking the current. The contact breaker may be composed as in Fig. 3.

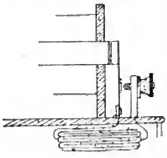


FIG. 3.

A small iron hammer, 1¼ inches in diameter, supported upon a spring of brass having a screw touching against it. The points of contact should be platinum, to guard against corrosion. The hammer is opposite the end of the iron core and works thus—the current comes from the battery through the screw and spring to the primary coil and back to the battery. This makes the iron core a magnet, which attracts the soft iron hammer, dragging the spring away from the point of the screw. This breaks the current, the core ceases to be a magnet, no longer attracts the hammer, and spring flies back again, making contact. Another form of contact breaker is that shown in Fig. 4.

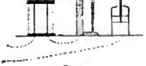


FIG. 4.

A rod is pivoted in the center, at one end of which is a platinum point dipping into mercury, on the other is a soft iron armature, below which is an electro magnet. The current from the battery flows to the mercury up the platinum point, along the rod, down the support, and round the magnet wire, through the primary, and back to the battery. This excites the magnet which attracts the armature, raising the point out of the mercury, breaking contact, current ceases and the spring pulls the rod down, again making contact. The mercury is covered with a layer of paraffin oil, to prevent sparking and also oxidation of the surface. For large coils the last named is the best, being more under control. For continuous currents a condenser is required, and is for the purpose of receiving the current induced in the primary on the break of the current by the contact breaker, which would otherwise leap across the gap between contact breaker and platinum point. The charge stored up in the condenser also assists the current in the primary wire on the make of the current. It is composed of 200 sheets of tinfoil, 9 inches by 9, having a layer of good paraffined paper between of slightly larger size than the tinfoil, the corners of alternate sheets being joined together, and each set being joined to the contact breaker as in Fig. 3, which shows the condenser in position; the condenser should, when finished, be placed under heavy pressure until the paraffin wax has set. It is most important that no connection exists between the two sets of tinfoil sheets, as this would short circuit the contact breaker and no effect would be produced upon the coil. The end of the primary should be joined to the foot of the spring in the first kind, and to the magnets in the second kind of contact breaker, the screw in the first and the mercury in the second being joined by a No. 14 B. W. G. (12 Am. W. G.) wire to a large terminal. The other end of the primary is joined to a like terminal, placed about two inches away. The wire on the magnets of Fig. 4 must be the same as the primary wire. The secondary terminals should be placed as far away as possible from the primary terminal and contact breaker, as a spark from an induction coil such as this would be very dangerous, if not fatal to some people. Sparks should not be taken to the body when above ½ inch in length. If the current be taken from the lighting mains a variable resistance must be placed in series with the primary; enough to bring the current down to about six amperes, this being quite enough to run the coil. As this depends upon the size of the house leads, the advice of a competent electrician should be taken before attempting, or the mains may easily get fused, owing to the resistance of the primary being very small, about half ohm. If an alternating circuit be used for lighting, an ordinary resistance cannot be used, but a device known as a "choking" coil is used. This is a coil of thick wire, containing an iron core, which can be moved in or out, the farther the core is in the less the current; but, as above, advice should be taken before meddling with any electric lighting mains. A "choking" coil requires adjusting for every circuit. In the last case the condenser and contact breaker are not required, the oscillations of the alternating current having the same effect. If high frequency and potential be required, and very small current, the following device may be adopted.

One terminal of the secondary is connected to the inner coating of three half gallon Leyden jars, the outer coatings being connected to earth. The inner coatings of the jars are connected to a gap between two highly polished brass balls of an inch in diameter and about a quarter of an inch apart; the other side is connected to a coil of well insulated wire (about one pound of No. 32 B. W. G., 31 Am. W. G.) wound on an ebonite tube and well soaked in paraffin wax, the other terminal of the coil is connected to three Leyden jars, as in the first case, but with no spark gap being connected directly to the other end of the coil. Another coil of wire is wound over the first, being well insulated from it. A very high frequency of alternation is produced in the last coil, providing a continual discharge takes place across the gap (see Fig. 5). All the effects produced by

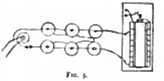


FIG. 5.

Tesla before the Institute of Electrical Engineers can be produced, on a smaller scale, of course, by the above apparatus; and it has been said the X rays are produced most readily by these means. An ordinary incandescent lamp globe, of which the filament is broken, can be used for all the above mentioned Tesla effects, but is usually not highly rarefied enough to produce Prof. Roentgen's X rays. The tubes required for this work are those first produced by Crookes, and used by him for studying his radiant matter (see Electrician, January 16, 23 and 30, 1891), and are glass bulbs having an exceeding high vacuum, much higher than the ordinary "vacuum," or Geissler tube, which is of no use for this work—at all events, without exceedingly long exposures. The connections with the interior are made by means of platinum wire fused into the glass, this metal being the only one which has about the same coefficient of expansion as glass. These electrodes, as they are called, end in the pattern of tube most used in England, in a ring of aluminum and a disk of the same metal, respectively. (See Fig. 6.) The bulb is pear-

FIG. 6.

FIG. 7.

shaped, the disk suspended from the smaller end and the ring projecting from the side about three-quarters of an inch below the disk. Disk and ring are of about one inch in diameter. The generally used Continental form (which is also made in England) has no ring, only a wire projecting from the side, the disk being nearer the top of the tube. (Fig. 7.) The discharge is of a pale violet, the glass of the tube fluoresces an "apple green" tint.* The high vacuum in these tubes is obtained by means of a mercury pump, of which the Toepler is a good form, which I will describe (see Fig. 9). The diagram shows one form of the Toepler pump. In the other, the long tube, d, is replaced by a mercury valve, thus doing away with the liability of fracture of the long tube. The tube, a, has a bulb, b, of comparatively large capacity, blown at the upper end. Out of the upper end of this runs the tube, c, from which the

* The form of tube finally adopted by Prof. Roentgen himself is shown in annexed sketch, Fig. 8. It is being made by Baird & Tatlock, Cross Street, Hatton Garden, E. C., to whom we are indebted for the use of the first example made, from which to make our sketch.

air is discharged. The air enters from the tube to be exhausted by the tube, d, on to the end of which it is fastened either by fusion of the glass or else by an air-tight joint of rubber. The tube, a, is about 40 inches long to the bulb; c is about 36 inches from the level of the top of bulb; d is about 30 inches high. The reservoir, e, containing mercury is connected to the lower part of a, by means of a flexible rubber tube, and is long enough to be raised above the bulb, and contains enough mercury to fill the bulb and tube, a. The operations are: The reservoir is raised to fill the bulb, b,

FIG. 1.

the tube is fastened on the end of d, c dipping below mercury. The reservoir is now lowered, the air rushes into b, from the tube being exhausted. The mercury has risen in c, by the pressure of the atmosphere. The reservoir is again raised, cutting off d, and forcing air out before it through c; the operation is again repeated, always driving all the air out of c, by allowing a small quantity of mercury to flow over from the bulb. If very high vacua are required, the tube to be exhausted is filled with carbon dioxide and exhausted, the residual gas being absorbed by a tube containing caustic potash being placed between the tube and a, the bulb is sealed off by a blowpipe flame before withdrawal from the pump. The extent of the vacuum can be judged approximately by the tube, c. When this stands at the barometric height, generally about 3 inches, when the reservoir is in the position of the sketch, the vacuum is fairly high. Gas is absorbed by the aluminum electrodes, is gradually given out, and will impair the completeness of the early obtained vacuum. This can be got rid of by heating the partly exhausted tube, and if an induction coil be joined to the electrodes, the extent of the vacuum can be gaged from the discharge produced in the tube. The tubes are beyond the scope of any one except an experienced glass blower, and the exhaustion is very difficult, and they are, therefore, better obtained from a manufacturer. The exhaustion generally takes a large amount of time.

To return to our coil. It may be mounted upon an ebonite or mahogany base containing a cavity in which the condenser is placed. The frequency of the dis-

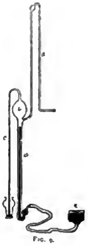


FIG. 2.

charge may be increased by tightening the screw of the contact breaker, the greatest being obtained when it is giving the highest note. If a smaller coil be required, say a two inch spark, the core should be composed of iron wire (No. 30 B.W.G., 28 Am. W. G.) treated as described above, about ten by one inches, the primary wire two layers of No. 16 B. W. G., 14 Am. W. G., double cotton covered and insulated as described above; the secondary is composed of four pounds of No. 38 B. W. G., 40 Am. W. G., wound in sections, double silk covered. A hammer contact breaker should be used for such a small coil as this. The condenser should be about 100 sheets of tinfoil, nine by seven inches.

The wire is, of course, the most expensive article, and should be obtained direct from the manufacturers. The paraffin wax can be obtained from the dealers in electrical goods. It should not be heated too high, as this slightly destroys the insulating power; it is best heated in a water bath, as paraffin wax melts at about 100 F. The weight of the six inch coil will be about twenty pounds. Shellac varnish can be used for insulating purposes, and the glass pillars of the secondary terminals should be coated with it inside and out if tube be used. Thin wires only are needed for connections to the secondary coil, as the current flowing is exceedingly small, the potential being very high.

The Leyden jars can be made of half gallon glass jars, the glass not too thick and as white as possible, coated inside and out with tinfoil pasted on to about four inches from the top, the bare glass being coated with shellac.

A new imitation gold has been prepared by Theodor Held, Menien, Germany. It is an alloy of copper and antimony in the proportion of 100 : 6, and is prepared by mixing the antimony with the molten copper at a certain temperature. The antimony is previously cast in gold. By these precautions a malleable metal is obtained, instead of, as usual, a porous substance. The alloy has a high tenacity, and is, in fact, harder than gold itself. When finished it cannot be distinguished from the precious metal at sight, even by experts.—Uhland's Wochenschrift.

ON THE EFFECT OF MUSIC ON CAGED ANIMALS.*

By FRANK COLLINS BAKER.

SOME time ago the writer was induced to experiment upon the animals in the Zoological Garden in Lincoln Park, with respect to the effect of music upon them, and the result may be of some interest to others working on psychological lines. The experiments were made at 6 o'clock P. M., two hours after feeding, and the instrument used was a violin.

Felis concolor Linné. Puma Panther. When the music first began, two specimens of this species were resting in the back of the cage half asleep. At the first sound of the violin they started up, and could not for a time locate the sound, the writer being some distance from the cage. They showed, however, that they liked the sound, and when the player came as close as he could to the cage, they manifested their appreciation by lying down at full length and placing their heads between their paws. During this time the music had been of slow and sweet pieces, such as "Home, Sweet Home," "Annie Laurie," etc., etc. Suddenly, the player changed "Home, Sweet Home," to the "Irish Washerwoman." At this change the panthers worked their tails nervously, and twitched their ears, and as it was kept up for a time, they got up and began pacing up and down the cage. From this action the writer judged that either the jig music, being sharp and piercing, hurt their ears, or that it was distasteful. After playing several jigs of this kind the player again relapsed into soft strains, when the animals slowly settled down in their old positions.

Felis onca Linné. Jaguar. This animal behaved much as did the panthers. While the jigs were being played he acted in a very nervous manner, jumping from a shelf to the floor of the cage and back again. Soft music seemed to quiet him. As the writer was leaving the jaguar's cage, having ceased playing for the time being, the animal walked up to the corner and reached out with his paw toward the player as far as he could. Whether this action was intended to call the player back or was simply done to catch hold of him, as many animals will do if a person gets too near to the cage, the writer cannot say. It was a curious fact that when the paw was extended the claws were all retracted.

Felis leopardus Linné. Leopard. Two specimens of this species did not seem to notice the music to any extent, except at first, as a matter of curiosity.

Felis leo Linné. Lion. The lioness Juno, with her three cubs, occupied a large cage, and the player's attention was next directed to these. While the music was being played to the other animals the lioness and cubs had been listening and watching, the cubs playing about their mother's haunches. As the violinist drew near the cage the cubs scampered behind their parent, the latter greeting the player with a gentle hiss. As the music struck up a lively jig the cubs stood upon their hind legs and peeped at the player over her haunches. They appeared very curious and much puzzled, hearing these sounds for the first time. Desiring to test their appreciation, the player slowly backed away from the cage, playing all the time; as he retreated, the cubs gradually came to the front of the cage, and the mother crawled to the front and placed her two forepaws between the bars and stuck her nose through as far as she could. After retiring to the side of the hall the player again moved toward the cage, but the family did not move, nor evidence any displeasure when he came very close to them; in fact, so close that he almost touched the great paws of the lioness. As he played the soft strains of "Home, Sweet Home," the cubs and mother sat motionless, in rapt attention, the former turning their heads from side to side. A jig played very rapidly caused the cubs to prance about in a lively manner.

Felis tigris Buff. Bengal Tiger. The music had a peculiar effect on the pair of animals in this cage. The male paid absolutely no attention to it, save glancing in the direction of the player and giving a vicious snarl. The female, however, acted as though she liked it, for she jumped upon a shelf and placed her paws and nose through the bars as described under the last species. A second experiment with the male, later, when he was stretched out upon the floor of the cage, caused him simply to look at the player, twitch his ears, and viciously spit and snarl at him. The female, however, on all occasions showed that music was not distasteful to her, and that it was, on the whole, pleasing.

Hyena vulgaris Buff. Hyena. This animal is probably the most cowardly of all the mammals, and the only effect which music had upon two individuals was to cause them to retreat to the farther end of the cage and try to squeeze out between the bars. A lively jig frightened them nearly to death, and made them tremble in every limb. Strange to say, however, they did not howl or make the least noise.

Quadrumana. The Monkeys. (Genus Cynocephalus.) The monkeys evidenced great curiosity at the music, but did not seem to show either pleasure or displeasure at the sounds. A South American sooty mangabey, however, seemed to be rather pleased with the strains, particularly the jigs. This animal is of a quarrelsome disposition, and is, therefore, kept separate from the other monkeys. It was thought by Mr. Sweeney, the keeper, that the sounds might awaken a feeling of anger in him, but such was not the case. As the violinist drew away, he followed as far as his cage would allow. A spark of reason was observed in this animal. His cage is of glass all around, and in order to hear the music better he placed his ear to a crack in the door. This he did several times as the player drew near or went farther from the cage. The monkeys confined in the larger cage, also of glass, formed themselves in a broken semicircle about that part of the cage nearest the violinist, and looked at him in apparent wonder. As he moved away from them, they arose from their sitting posture with one accord and followed him along the side of the cage. This was probably simply curiosity, although the music may have given them some pleasurable sensations. On the whole, the monkeys did not show as much intelligence as might have been expected from their high position in the scale of nature.

Pelecanus fuscus Linné and P. erythrorhynchus Gm. Brown and White Pelicans. The pen containing these birds is situated next to the monkey cage, and the music was next tried upon them. The effect was somewhat startling, for they all began to jump about, flap their wings, and snap their huge beaks; this might, perhaps, be called dancing. When the violinist drew near the cage, they snapped at him with their beaks.

The other birds in the animal house paid very little attention to the music, partly, perhaps, because they were sleepy. Several varieties of parrots, herons and smaller birds were tried in turn, but without producing any results worthy of mention.

Canis latrans Say. Coyote. The last experiment tried was upon a den of coyotes in the park. When the playing began all the animals were in their holes, but the first note had hardly been struck when they came running out, and raced up and down their den until they had located the sounds. When this was done they all squatted in a semicircle about the violinist, he having approached the bars of the den as near as possible, and sat in silence listening to the music. When it ceased they ran up to the player and pawed at him through the bars, indicating as plainly as possible that they wished to hear more. When he began to play again they again silently formed in a semicircle. This experiment was tried a number of times, but always with the same result. During this time not a sound was uttered by the coyotes, but a wolf in the den adjoining howled lustily. Here, as in the other cases, soft, sweet music seemed to be better appreciated than loud, harsh music.

Besides music made up of regular pieces, all sorts of sounds were made by the violinist—screeches, piercing notes, imitations of a cat, cow, rooster crowing and pig squealing, but these did not seem to have much effect. The loud, harsh and piercing notes seemed to affect their ears, for they moved them about nervously as though the noise hurt the sensitive nerves. To sum up general impressions, slow and soft music was received, as a rule, with more signs of pleasure than the lively jigs. The females, also, seemed to pay more attention to the music, and to be more pleased with it, than were the males. The nocturnal mammals were more interested than were the diurnal birds. This was probably due to the fact that the experiment was tried after dark, when the animal house was lighted only by electricity. It was a curious and interesting fact that the whole performance was conducted without any noise other than an occasional grunt from the lions. The experiment is worthy of repetition, and should be made at different times during the day, as in the early morning and at noon, just before and after feeding, etc., to see whether or not these conditions have any effect upon the result. The writer is convinced that many interesting and valuable facts may be learned by experiments of this character.

*The American Naturalist.

SPINNING POWERS OF CERTAIN EGGS.

IT is well known that the protoplasm of many one-celled animals may flow out as excessively delicate threads of living matter that exhibit remarkable currents and contractile phenomena. Something similar to these fine "pseudopodia" is met with in certain cells of many-celled animals, as in the pigment cells of the retina, etc. In a recent paper by Gwendolen Foulke Andrews* it is claimed that the eggs of starfish and sea urchins form very much the same sort of delicate pseudopodial filaments as are produced in those one-celled animals.

These threadlike processes are "spun" out from the protoplasm of the egg in such exceedingly delicate filaments that they have escaped notice and have now been revealed only with good lenses and exceptional optic resources.

From the elevation of the egg's surface that meets the sperm a "tuft" of fine threads is spun out; the whole surface of the egg spins out fine threads to make the egg membrane; the egg spins during cleavage; it spins out the cilia that move the blastula; it spins filaments across the cleavage cavity and from one germ layer to another in the gastrula; and the polar bodies spin like the rest of the egg.

These threads spun out are flowing material that branches, anastomoses, shows currents and other phenomena very much as do the pseudopodial filaments of such one celled animals as Gromia.

The membrane that is formed after entrance of a sperm is made in the sea urchin by the following spinning phenomena. In normal eggs of Echinus clear, homogeneous, straight, smooth filaments flow out from the egg, very close together, and all attain the same length about the same time. These filaments then seem to fuse at the tips to make a ceilinglike film that grows thicker. The space between the filaments is then filled in—in some undetermined way—and thus the membrane is completed.

In abnormal eggs the spinning is irregular and more in the form of tufts and brushes that are more readily observed.

In the starfish after such a membrane is formed the egg sends out a tuft of threads from the place where the polar bodies were formed and then ceases to spin; soon the general surface spins again, and continues to do so during cleavage. These filaments branch and anastomose; they may bend suddenly at the base and even bend over at right angles at some point in their course; they may start from the surface of the egg at various angles, even tangentially; they may run out and attach themselves to the egg membrane.

When cleavage of the egg begins the spinnings show peculiar activity near the plane where the cells will separate. As the cleavage furrow is formed, threads spin from one side to the other, so that the two cells are connected by cross filaments as fast as they are separated by the plane of cleavage. The liquid between the cells is crossed by many most delicate strands and skeins of filaments that connect the two cells.

When the two cells subsequently approach and flatten against one another, the connecting strands shorten and thicken as if contracting to draw the cells together. When pressure is applied to such cells, the connecting threads appear as if resisting separation of the cells and as if more active in drawing them together.

Later, when more cells are formed, the same pheno-

*Journal of Morphology, February, 1897, pp. 267, 280.

mena are seen, and when the cleavage cavity is present it is crossed by a network of interlaced filaments spun out from the inner ends of the cells. These filaments connect adjacent cells and also the most remote cells of the blastula.

When the blastula is ready to swim, the external spinnings cease for awhile and then start again as numerous processes from the general pellicle, all becoming very long and active as the well known "cilia" that propel the blastula through the water.

In the gastrula stage both entoderm cells and ectoderm cells spin filaments that cross the blastocœle and connect all the cells. When the mesenchyme cells are formed they, too, spin many filaments that connect with the other cells and with other filaments, so that the blastocœle is traversed by a very complex network of anastomosing filaments arising from all the germ layers. These internal spinnings remain active up to the time of formation of the proctodeum, at least.

The polar bodies spin, from the first, very fine pseudopodial filaments that soon unite with the egg and with the egg membrane, as well as with filaments from the egg, so that the polar bodies are henceforth (up to the period of the late gastrula, at least) united to the egg, and to the resulting cells, by threads of living material.

The shape of the polar bodies may be changed as distorted by contraction of these filaments; and change of place of the polar bodies seems also to be due, at times, to contraction of the filaments.

In the anastomosing network that connects the egg with the polar bodies material is carried hither and thither in the currents that flow along the threads.

Eventually the polar bodies may be taken in to the blastula, through the cleavage pore, and henceforth be connected with the network spun out from the inner ends of the blastula cells and, later, with the filaments from the entoderm cells of the gastrula also.

The natural criticism that these spinning phenomena are abnormal, pathological, and hence of less wide interest, is met by the author with the statement that every precaution was taken to maintain normal conditions, and that the eggs described were from lots that formed normal larvæ, or even themselves grew into normal larvæ after the observations. Moreover, it is granted that heat, polyspermy, immaturity of the egg and adverse states of the water resulted in very profuse spinning phenomena; but these truly pathological phenomena were very different in character and easily distinguished from the less obvious phenomena believed to be undoubtedly normal.

It is thus claimed that in these normal Echinoderm eggs the protoplasm can project delicate living filaments. That these are concerned in the formation of the egg membrane. That they connect the cells during cleavage and gastrulation, so that the protoplasm is continuous throughout the larva and not separated by the cell walls.

As appearances indicate that these connecting filaments are contractile and that they aid in drawing the cells together, they may thus prove to be the basis of the so-called "cyto-tropic" movements exhibited by the blastomeres of various eggs.

Moreover, as these filaments are living bands and as material passes along them from one cell to another, the author thinks they may prove to be the means of that co-ordinating communication in the cell aggregate postulated by certain workers in the field of experimental embryology.

The polar bodies are said to spin like the cells of the egg for a long time after their formation and to remain so long in protoplasmic continuity with the other cells that there is a possibility they may not be entirely without a place in the developmental changes.

The peculiar activities of the protoplasm of these eggs, together with many general questions connected with such phenomena, will be considered in a second paper, now in press.

Though these remarkable phenomena are new to our knowledge of eggs, the reviewer would suggest that what is here seen as living filaments may have appeared to other observers as a protoplasmic envelope on the outside of the egg. Thus it may be that the very thick covering "Protoplasma mantel" figured and described by Selenka* in the Ophiurid Ophioglypha lacertosa and the much thinner "Protoplasma schicht" in the Echinid Strongylocentrotus lividus, which also enters the cleavage cavity, are really a collection of spinnings, possibly somewhat pathological. In the last named case this outer envelope of the egg has recently been emphasized by Hammar† as a connection between the cells.—The American Naturalist.

ELECTRICAL TREATMENT OF PHYLLOXERA.

VARIOUS methods have been tried for making life unpleasant for the phylloxera and saving the vineyards, which else appeared doomed, says the English Electrical Engineer. One promising method, extremely unpleasant to others as well as the phylloxera, involved the extensive application of carbon disulphide. According to L'Elettricità, in Italy, or, at any rate, in the island of Elba, they have tried electricity. The inventor, who has the un-Italian and Teutonic-looking name of Furin, has established at Porto Ferrajo a method of killing the phylloxera on the vine by puncturing the stem with a needle, and sending a current down to the roots. The operation has to be repeated about three years in succession, and is said to cost under 50s. per acre. The action of the current is ascribed to the production of ozone, and the vitality of the plant is said to be in no way impaired by the treatment. There are no details as to voltage or current used, and it may also be added that L'Elettricien some months ago stated that experiments recently made by an engineer of the Siemens & Halske Company to destroy the phylloxera on vines, by means of ozone generated by electricity, had given unfavorable results.

According to Austro-Hungarian patent law, patents may be taken from their holders for an appropriate compensation, if it be in the interest of the army, government or the public.—Stahl und Eisen.

* Studien über Ent. Wth. 2 Wiesbaden, 1883.
† Archiv. f. Mik. Anat. March, 1896.

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SINGLE RAIL RAILWAYS—THE BEHR SYSTEM.

THE main feature of the Brussels International Exhibition, now in progress, is the Behr monorail railway, on which Mr. Behr is said to have expended $150,000, and by which he expects to demonstrate that the system is the one best adapted to maximum speeds. For our illustrations and the accompanying details we are indebted to Engineering.

There is, of course, nothing new in the idea of a single rail railway. Long before Lartigue's time it had been put in ineffectual practice. As long ago as 1826 the notion found favor, was tried and abandoned, to be taken up again and again uselessly. Of late years the most elaborate experiment was the Meigs elevated single line railroad, built at Boston, and tested to absolute discredit. There have been but two systems, of modest application but of undoubted value, on these lines of invention. These were the Lartigue monorail railway and the Caillet system.

Charles Lartigue's invention was an admirable one for its special purpose. He was the engineer to a French company in the large agricultural interests in Algeria. Decauville lines were laid down over the company's estates, but they proved a failure, on account of sand storms that buried the permanent way, obliterating the track often in a few hours. On this account Charles Lartigue built his lines on trestle work, with a single rail, and made his wagons pannierwise; by this means he surmounted the difficulty of the sand storms, and was able to haul his crops without interruption, by mules. With the hopefulness of the inventor, he believed that what was well adapted for an Algerian desert should find a wider application, and he exhibited his elevated railway with a modified construction at an exhibition held at Rouen, about 1883. Again, it appeared in Paris, in 1884, at an agricultural show, for M. Lartigue's ideas of the usefulness of his system did not appear to go farther than its application to agricultural purposes. The line at the Paris show was only a few hundred yards in length, but it was an exhibit of special interest, for the train of cars was propelled by electricity, the current and motors having been furnished by Messrs. Siemens. It was the prototype of the present experiment at Brussels, but it found no practical adoption.

During the following year Mr. F. B. Behr, of 6 Old Jewry, became interested in the Lartigue railway, and sought a wider field for its application. He built the experimental line at Westminster in 1886, and did not convince the public, nor possibly himself, that the system could be profitably applied to ordinary railways. Still, his experiment led to practical results. In 1888 he completed a passenger and freight line from Listowel to Ballybunion, a distance of 10 miles; and this line is still in profitable operation, though, of course, on a small scale, with light traffic, except during the tourist season, when it is busy enough. In France there is another railway—a state railway—about 12 miles long, from Feurs to Panissières, a minor branch of the Paris-Lyons-and-Mediterranean Railway. In other parts of the world—in Russia, in Trinidad, Guatemala, and elsewhere in South America—there are some 15 or 20 of these lines in successful working, none of important length, and nearly all used for hauling ore, the system being found well adapted for this purpose, where difficult localities involving sharp curves render the use of aerial railways impracticable. At a Spanish mine in the Pyrenees one of these railways is worked electrically.

None of these insignificant applications of the system has anything in common with the latest development, and until now it has never been pretended that the monorail system could secure higher speed, greater safety, and more comfort to passengers than the ordinary railway. But the history we have so briefly sketched is interesting, as linking together the little sand-swept tramway in Algeria with the bold experiment of Mr. Behr at Tervuren.

THE BEHR SINGLE RAIL RAILWAY—INTERIOR OF CAR.

The monorail exhibit consists of three parts, not counting the various objects shown to illustrate the early history of the system. These are the permanent way, the carriage, and the power station. The length of the line is about three miles, and consists of two parallel straight portions connected by curves at each end of about 1,600 ft. radius; these arcs of circles are joined to the straight lengths by transition curves. The line is not level throughout, one-half the distance, including a part of the curves, being laid with a grade of 1 in 100. The great ring fence inclosing this ellipse does not lie within the limits of the Tervuren Park, but extends from one end of it, so that the entrance to the exhibit is situated on the boundary of the park.

While Mr. Behr limits his estimate of speed to something less than one hundred miles an hour, he will conduct a series of experiments to ascertain the maximum rate attainable. It may be added that his experiment is being watched with much interest by the Belgian Corps des Ponts et Chaussées, and a report by state engineers will be prepared at the end of the exhibition.

The railway being continuous, and there being only one vehicle placed on it, there is no need for sidings, or for any switches or their equivalent, but devices for effecting junctions form a subsidiary part of the exhibit. The carrying rail is placed on the top of a triangular trestlework of steel, strongly braced in all directions, and resting on steel crossbearers laid in the ballast. Besides the single top rail, there are attached on each side of the trestlework two rails of a special section, and laid flat with the heads outward. These serve as guide rails, on which several series of small inclined wheels mounted on the carriage take a variable bearing as the train is in motion. The triangular members of the trestle are about 4 ft. high, the distance from the top of the sleeper to the bearing surface of the rail being 1·250 meters. The standards are placed at distances of 1 meter (39 in.) apart, except at rail joints, where the distance is made one-half. The carrying rail is of ordinary section, and 82 lb. to the yard. The conductor is attached to the sleepers, and is supported on insulators secured to the sleeper by stud bolts, the conductor rail being held by two screws provided with spring washers. Copper strips form the connections between the conductor lengths.

The carriage is provided with pointed ends to diminish the air resistance, and the inclined faces forming the ends are fitted with adjustable vertical louver plates which can be opened with the view of utilizing them as air brakes. The compartments inclosed within these pointed ends are occupied by the driver and conductor of the car respectively. The vehicle has a sitting capacity for one hundred passengers, arranged in four rows, two on each side of the carrying rail. There are two electric motors to each truck, making four in all. These are placed in the lower part of the carriage body below the seats. The bottom of the car extends to within a few inches of the sleepers, and is incased throughout. Within this space is a large amount of mechanism, including the sets of lateral wheels that bear against the side guiding rails. The two trucks, of four wheels each, running on the main rail, are within the recess formed by the framing of the seats. The weight of the carriage in running order is about fifty-five tons. The vehicle is 58 ft. long and about 11 ft. wide. It is framed entirely of steel. Its bottom edge is 7 in. clear of the sleepers, and the floor level is about 5 ft. above, the height of the bearing rail from the sleepers being 4 ft. 1⅛ in. From the floor or upper deck of the carriage the sides rise so as to give a lofty inclosure for the passengers, and the roof is arched. The carriage is made with a deep recess running for its whole length to receive the wheels and trucks on which it is carried. The driving and guiding mechanism is contained in the hold of the carriage, the electric motors being attached to the framing of the lower deck. Internally the carriage is divided into compartments, one of which, 20 ft. long by 5 ft. 6 in. wide, being reserved for the use of royalty. No expense has been spared in the luxurious internal fittings of the compartments, which are upholstered in Utrecht velvet, the joiner's work being

THE BEHR SINGLE RAIL RAILWAY—EXTERIOR OF CAR.

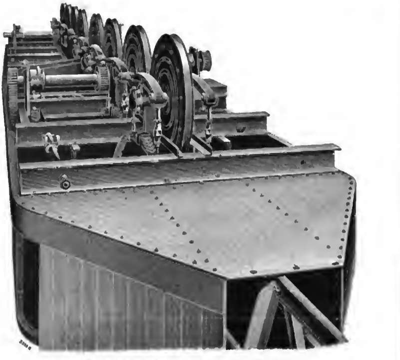
in Spanish mahogany, and the roof linings of imitation leather. The weight of the carriage is about fifty-five tons, which is considerably in excess of the designer's intention, the weight originally proposed having been forty-seven tons. There is evidence throughout the whole structure of remarkable skill and ingenuity in providing against the many unknown conditions that will be met with when running at the velocities intended, and whatever may be the result finally attained, Mr. Behr deserves the utmost credit for anticipating and preparing for every difficulty that can be foreseen.

As will be seen from the sectional view, the roof of the carriage is double, the distance between the outer and inner casings being sufficient to admit of a device for supplying air to the interior of the carriage without any violent draught. Ventilators are placed on the roof, and air flows through them into the space between the casings, where it is met by a series of baffle plates, that gradually reduce the velocity of the current, until it flows through openings in the inner casing, at a convenient rate. As will be seen from the longitudinal section, the carriage is lighted by incandescent lamps, taking their current from the main circuit. The triangular chamber in the bow of the carriage is reserved for the driver, who has at his command various devices for controlling the current, manipulating the special air brakes, and putting on the hand brakes for bringing the carriage to rest. The switch gear is very complicated, and would doubtless be capable of much simplification. Its functions are to couple the motors, two in series when starting, and afterward two in parallel, and for shunting the magnetic fields so as to obtain the maximum speed. Resistances are inserted in series with the motors when first switching on and also when they are first thrown into parallel. The switchboard, as well as the motors, was designed and made by Messrs. Thomas Parker, Limited, of Wolverhampton. One of the original features of the Behr carriage is the arrangement adopted for checking the carriage when running at a higher speed than could be controlled by existing forms of brakes. For this purpose the tapering ends forming the bow of the carriage are fitted for their whole height with a series of louver plates turning on vertical spindles, the lower ends of which are extended beneath the floor and carry worm-wheels that gear into a series of worms on a horizontal shaft. By operating the handwheel all the louver boards on each side of the bow are opened more or less at the will of the driver, and air resistances are created by the exposure of the inner sides of the louvers and the side plates of the frame. It is intended that as soon as the speed is reduced to convenient limits by this means, the stop should be completed by means of the hand brakes, which can be applied to each wheel of the carriage.

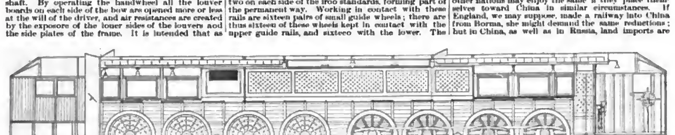
The carriage is supported by eight wheels, 4 ft. 6 in. diameter, mounted in two four-wheeled trucks which are coupled at the center by means of a universal joint. The very short axles of the wheels run in boxes mounted on pedestals that are riveted to the main frame, and the carriage is hung on the boxes by means of cast-steel curved hangers to springs, one on each side of the wheels, the springs being beneath the axles. The general arrangement is shown in the sectional view. There are four electric motors, placed in the hold of the carriage. Thus two wheels of each truck are driven, the two outer wheels running free. The motors are of the four pole type, with toothed armatures wound with Eickmeyer's coils. Each motor is designed for developing 150 horse power when furnished with a 700 volt current and running at a speed of 600 revolutions per minute. As will be seen, the motors are bolted to the lower deck of the carriage, and a rigid distance piece connects the motor shaft with the axle of the driven wheel, the speeds of each being equal. The means of transmission is a Renold steel chain, which appears to have given satisfactory results when tested at the Gloucester works. As already explained, the motors are controlled by a switchboard placed in the driver's compartment. When the carriage is started, the four motors are connected in "two-parallel-two series" with a resistance in series between them. This resistance is gradually removed, and the connections are then shifted, until all of the four motors are connected in parallel with the resistances in series. This resistance is then cut out, and the motors in parallel are connected directly across the full electromotive force. If a higher speed is desired than is obtainable by the normal mode of working, the series field winding of the motors is shunted through the resistances. The current for the motor is taken from a conducting rail laid on the sleepers with insulators interposed for the whole length of the track. The current is supplied to the motors through collectors on the carriage, kept in contact with the conductors, and the position of which is shown in the sectional view. The return circuit is made through the wheels of the trucks and the carrying rail.

Besides this carrying rail there are four guiding rails, two on each side of the iron standards, forming part of the permanent way. Working in contact with these rails are sixteen pairs of small guide wheels; there are thus sixteen of these wheels kept in contact with the upper guide rails, and sixteen with the lower. The wheels are 18 in. in diameter. Slots are cut in the steel plating of the carriage adjoining the rails for the wheels to pass through and make contact with the guide rails. The shafts are mounted at the ends of an adjustable frame, shown in the sectional view, and secured to the main frame of the carriage in such a way as to maintain the wheels in contact with the guide rails. The principal work that will be thrown on this device will be in passing round the sharp curves which are characteristic of the Tervuren experimental line.

The electric station which is to supply current for the Behr carriage is being furnished by the exhibition authorities, but unfortunately it is still far from being complete. Indeed, although we believe that at the present time about one-fourth of the ultimate power is available, some time must still elapse before the full energy will be available.



THE BEHR SINGLE RAIL RAILWAY—BOGIE TRUCK.



THE BEHR SINGLE RAIL RAILWAY—SECTIONAL VIEW OF CAR.

THE MANCHURIAN RAILWAY.

THE Times correspondent, writing from St. Petersburg, February 5, says: A commission of engineers now holding sittings here for the purpose of discussing technical questions concerning the construction of the Manchurian railway under the presidency of the chief engineer, M. Yugovitch, will leave St. Petersburg for Manchuria about the middle of March. The rest of the year will be spent in completing surveys. There will be considerable work in tunneling at both ends of the line, especially on the eastern section toward its junction with the Ussuri branch of the Siberian railway. Although the articles of association fix next August as the latest time for beginning work, the actual construction of the line is not likely to be commenced before 1898. The Eastern Chinese Railway Company are contracting for about 15,000 tons of rails annually during six years, and will probably order several steamboats and a large number of barges for the river Sungari. The increased number of boats belonging to the two Amur steamship companies are still unable to cope with all the demands created by the new situation. The Sungari, if not too shallow for heavy goods, would be the best channel for transporting railway material from the Amur on to the route of the line through Manchuria. If possible, the Manchurian line will be begun at both ends, but unless the Sungari can be used as suggested, there will be some difficulty in getting the necessary material on to the spot, especially as the Transbaikal section of the Siberian Railway, of which the Manchurian line will be a continuation eastward, will not be completed for some time to come. It will be easier probably to transport the rails and begin from the eastern end at Nikolsk. A sufficient number of native laborers, it is expected, will be found in the country at very cheap rates. In all probability the surveying and working parties will be escorted by Cossacks. In fact, travelers from Siberia report that Cossacks have already been seen in the frontier settlements on Chinese territory. The company, however, say they will have no need of Cossacks unless their rights and property are seriously endangered, and the police force which they are now taking steps to enroll prove unequal to the occasion.

Other travelers' stories bear upon some kind of projected railway from Kiakhta, which would be far more important and profitable for strategical and commercial reasons, but we may assume that the Russians will have enough to do for the present with the line they have already undertaken to build. There is certainly an idea entertained on the Chinese side of effecting a junction between the Chinese railway running to the Manchurian border near the Gulf of Pe-chi-li and the Russian line from Siberia. It must be borne in mind that no one has yet seen the text of the contract made between the Chinese government and the Russo-Chinese bank, which may or may not contain more than has been only incidentally disclosed by publication of the charter granted by the Russian government to the railway company formed by that bank. Whether or not that contract was a tripartite agreement in which the Russian government also took part, as some persons are inclined to believe, there is no doubt that the disclosure of so much of its contents as appeared necessary was calculated to discredit the alleged treaty between the two governments, and the latter as published in the English press is now commonly regarded here as the draft of a compact solicited but never really concluded.

In regard to a remark some time ago in the Times as to the reduction of duties made by China for the benefit of Russian importers via the Manchurian Railway, it is pointed out that it is a mistake to suppose that the favored nation clause will entitle other nations to claim a similar privilege. This advantage is given by China to the Chinese Eastern Railway Company—a private association—and not to the Russian government. The reduced duties, besides entire exemption for transit goods, are simply for overland imports, and other nations may enjoy the same if they place themselves toward China in similar circumstances. If England, we may suppose, made a railway into China from Burma, she might demand the same reductions; but in China, as well as in Russia, land imports are

taxed differently from those received at the seaports, where all nations in this respect are treated alike. For example, tea imported into Russia overland through Kiakhta is charged with 25 per cent. less duty than tea entering Russia by sea. There is even a differential tariff for the importation of seaborne coal, which is much higher at St. Petersburg and the Baltic ports than at those of the Black Sea. It is not a government that is favored by a reduction of duties on goods introduced by means of the Manchurian Railway, but a private company. The privilege was granted in the concession in lieu of a subsidy to help to make the line a profitable undertaking. The Russian vice president, M. Kerbets, one of the ablest railway men in Russia, will consider himself in the service of the Chinese government, like Sir Robert Hart at the head of the Chinese customs. I may add, in conclusion, that M. Kerbets is also chief director and manager of the Vladikavkaz Railway Company, which is now extending its line from Petrovsk along the coast of the Caspian through Derbend to Baku, and will shortly begin another most important and difficult railway across the mountains of the Caucasus from Kuban district to a point on the Black Sea coast near Sukhum Kaleh, thence to a junction with the railway of the Transcaucasus from Batoum. When these two railways are completed the Transcaucasus will be directly connected with the main Russian system at both ends of the great mountain range abutting on the Black Sea and the Caspian.

HURDY-GURDY OR TANGENTIAL WATER WHEELS.

By PHILIP R. BJORLING, in the Colliery Guardian.

TANGENTIAL water wheels, like the Poncelet water wheel, in some respects resemble turbines, but they are simpler in construction, less liable to choke or get out of order, and can be worked by much greater height of fall than any turbine yet designed. They may be termed tangential reaction water wheels, the power being derived primarily from the pressure due to the head of water supplied by a pipe discharging upon the wheel buckets by a nozzle, the size of which is proportional to the amount of water available and head and power required. Some makers of these wheels guarantee 80 per cent. effective duty out of the power due to the height of fall, and some even claim that as high as 88 per cent. has been obtained. The original bucket consisted of flat plates, but it was afterward found better to receive the stream on a strip edge, so as to divide it, and terminate the sides of the bucket by a curve, so as to reverse the current of water. The principal difference in these water wheels constructed by the various makers consists in the shape and position of the buckets, and in the manner in which they are regulated.

The Dodd "sigmoidal" bucket, illustrated in perspective in Fig. 1, is provided at the center with a midfeather which divides the water jet.

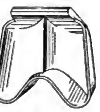


FIG. 1.

Fig. 2 illustrates, also in perspective, Mr. Knight's bucket, in which there is no midfeather, but the inventor claims the advantage that he can apply a larger amount of water with a single nozzle, and can, therefore, use his wheels for low heads.

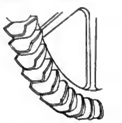


FIG. 2.

The Berry wheel is illustrated in Fig. 3, in which A is the line of the jet meeting the buckets, B, which are secured to the wheel with bolts. The buckets are radial and their convex face presented to the jet; they

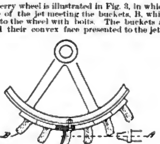


FIG. 3.

are formed with a double curved bottom, presenting a sharp dividing apex in the center which splits the stream of water discharged on the wheel, and also curved in the opposite plane so that they will present a convex surface, normal to the stream of water, in all positions of the buckets.

The wheel which is most extensively used, especially on the Pacific coast, is the Pelton water wheel, one of which, with a single nozzle, is illustrated in elevation (Fig. 4), enlarged sectional elevation of bucket (Fig. 5), and plan of the same (Fig. 6). This wheel is manufactured in this country by Messrs. Frazer and Chalmers. The buckets, A, secured to the periphery of the wheel, B, are of a peculiar shape, and divide the jet of water in such a way as to develop its full power, while in emerging they sweep against the curved sides with a reactionary influence, which has the effect of prolonging the impact. It is also by this means deflected from the wheel so as to offer no resistance to its motion. The

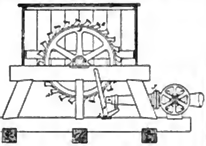
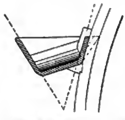


FIG. 4.

power of this class of water wheel does not depend upon the diameter of the wheel, but upon the head and amount of water applied to it. Where a great power is wanted under a comparatively low head, a larger wheel is necessary to admit of buckets of sufficient size to deal with a large stream. Wheels of greater diameter are also desirable in many cases as a means of reducing the speed, even in cases where the smaller wheels would furnish all the power required. For instance, buckets suitable for smaller wheels are frequently fitted on to wheels of larger diameter to reduce the speed; this is particularly the case when light heads are dealt with. The two or three nozzle wheels are only for the purpose of increasing the power by the use of a large amount of water, and the head is so low that a single stream or jet will not give the power required. These wheels have been working successfully with heads varying from 10 to 1,680 ft. One of the great advantages of this class of wheels is the facility with which wide variations of power can be produced without impairing the efficiency. This can be accomplished in three ways, namely:

1. By changing the size of the nozzle tip or tips, and by that means varying the size of jet or jets thrown on

FIG. 5.



the wheel, the power of which can be varied from its maximum capacity down to one-fourth of its power without appreciable loss, thus adapting it to a full supply of water when obtainable, or to a reduced quantity when from any reason the supply is limited.

2. The second method of varying the power is shown in Fig. 4, which illustrates a 6 ft. wheel fitted with deflecting nozzle, H. It is made 3 ft. 5 in. in length, attached to a ball and socket joint, J, and raised and lowered by a bell crank lever, K, working on a fulcrum, L. By this arrangement the whole or any part of the stream can be thrown on or off the wheel instantly, thus affording such variations of speed and power as may be desired to accommodate any change in load or supply of water. The amount of water wasted is so small as in most cases not to be worth consideration.

3. When great steadiness and even running is important, and the head is not sufficient to give the required power with an ordinary wheel of one jet, a wheel of larger diameter, allowing of a larger jet, is to be recommended, instead of using two, as the deflecting nozzle with a governor attached can only be used

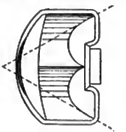


FIG. 6.

with a single nozzle. In such cases the nozzle lever is actuated automatically by a governor.

The peculiar feature of Mr. C. L. Hett's patent hurdy-gurdy wheel consists in an improved regulating nozzle, by means of which the power of the wheel can be changed without raising or lowering the nozzle, thus dispensing with the necessary ball and socket joint, and obviating waste of water.

The arrangement of the nozzle, when the regulation of speed or adjustment is performed by a hand wheel, is illustrated in Fig. 7, in which A is a casting pro-

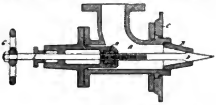


FIG. 7.

vided with the inlet branch, and bolted to the wheel casing, C; B is the nozzle into which is fitted a plug or spear, D, at the end of the screwed spindle, E, the latter working in a gun metal nut, H, and actuated by means of the hand wheel, G. It will be clearly seen that by turning the hand wheel the spear is either pushed into the nozzle, closing it, as shown in the illustration, or opened more or less according to requirements.

Mr. Hett's automatic nozzle is shown in sectional elevation, Fig. 8. It consists of the spear, A, and nozzle, B, as in the previous case, but in this instance the spear is actuated by means of the head of water acting on a piston in a hydraulic cylinder, the admission and discharge of water to and from the cylinder being regulated by a high speed centrifugal governor. In the illustration, C is the hydraulic cylinder and D the piston, the latter being secured to the spear. E is a piston valve, connected to the valve spindle and lever with the governor, H. The governor is driven in the usual way, with a belt from the wheel spindle. J is a passage for admitting water under pressure from the

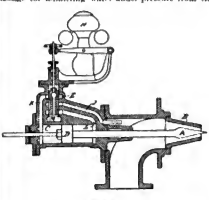


FIG. 8.

main inlet. K and L are ports for admitting and allowing the escape of water to and from the hydraulic cylinder. M is the discharge pipe. The action of this governing apparatus is as follows:

Assume the wheel to be running at its normal speed, the governor holds the valve, E, in midposition, as shown in the illustration, and the piston, D, in the hydraulic cylinder is in equilibrium and stationary. If the speed varies, the governor either rises or falls, moving the valve, which admits water under pressure to one or the other side of the piston, as the case may be, at the same time opening the delivery pipe and allowing water on the opposite side of the piston to escape. The piston and spear move and admit or cut off water to the wheel until the normal speed is again obtained. Two or more wheels may be used on the same shaft, where the head of water is low, to admit of getting the power desired from one wheel.

In Cadle's patent duplex hurdy-gurdy water wheel

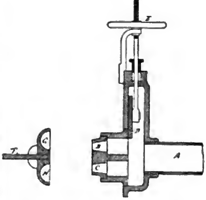


FIG. 9.

the buckets fit on the disk of the wheel into recesses, which are cast there to receive them. They are held in position by a single bolt passing through opposite buckets. No strain due to the impact of the water

comes upon the bolts; they simply serve to hold the buckets in their places, all the strain being taken by the lugs and ribs upon the disk into which the buckets fit.

Fig. 9 is a sectional elevation through the sluice, nozzles and buckets of one of the Cadle water wheels. A is the main pressure pipe; B and C the nozzles, regulated by the slide, D, and hand wheel, E; F is the rim of the wheel, and G and H the buckets. It will be noticed that the jets strike the bottom of the bucket, and turn the stream of water back to the direction from whence it came. In this wheel the slide is made to open one side of the nozzle at a time, so that when only one-half of the power is required the slide is only drawn half open.

Cadle's patent quadruple tangential water wheel is illustrated in sectional elevation Fig. 10. In this there

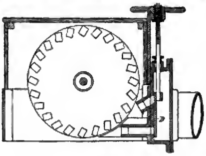


FIG. 10.

are two pairs of double nozzles, one pair above the other. The same slide, D, controls all the nozzles, it being so proportioned that when it is opened it first uncovers the lower nozzles, and a further movement opens the upper pair. By this arrangement the power of the wheel is doubled, and when only half power is required only the lower nozzles are opened.

The James Leffel cascade water wheel has the water admitted to it by one, two or more nozzles without decreasing the useful effect of the water; but the percentage remains the same, whether one or more be used. Each nozzle increases the power in the direct proportion of the increase of their number, requiring a proportional increase in the quantity of water. The peculiarity of the construction of this wheel is that the buckets are arranged alternately on each side of a central, sharp, continuous dividing ridge, projecting a little in front of the entering edge of the bucket. The dividing ridge has a sharp cutting edge, which serves to divide the jet of water before it reaches the buckets, and to keep it continuously divided into equal portions, so that each portion of this single jet is received separately on each side of the dividing ridge. Each series of buckets is so arranged that they catch the water alternately. It is claimed for this wheel that the alternate arrangement of buckets secures greater steadiness of motion, as it is equivalent to twice the number of buckets, and the forces are therefore distributed more regularly on the wheel.

The latest, and to all appearance the best, hurdy-gurdy or impulse water wheel is the one patented by Mr. F. M. F. Cazin, of New York, and manufactured by the American Impulse Wheel Company. This wheel is illustrated in Fig. 11. The slide, A, is so arranged

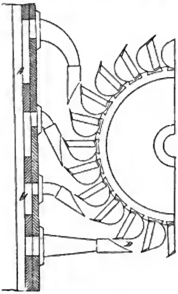


FIG. 11.

that one, two, three, or four nozzles can be used as required. Fig. 12 is a front view of a pair of buckets, Fig. 13 a plan, and Fig. 14 a cross section. The buckets are secured in their places on the rim of the wheel by means of a dovetail and bolts. The jet in an impulse wheel loses some of its maximum efficiency by the weight of the water being carried for some distance without support before striking the wheel, so that in this respect it is inferior to the turbine. In the Cazin wheel the nozzle mouth is shaped closely by and to the extreme circle in which the bucket revolves, as shown at H. It will be noticed that the bucket is curved every way, so as to perfectly reverse the current in every direction, and there is a lip which guides the jets into the bucket presented to it, and directly that is passed, into the next bucket. The diameter of jet is, as a rule, equal to the radius of the bucket cavity, which gives to half the jet four times its original width of space in which it may turn in its own course. For economical reasons the jets are made two-thirds of the

FIG. 12.

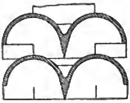


FIG. 13

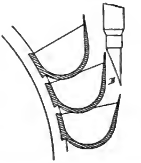


FIG. 14.

diameter of the bucket centers, as their diameter may be applied, which gives to the jet halves three times their width as space to inverse their direction of motion.

THE COEFFICIENT OF TRACTION OF CARRIAGES.

THE rapid progress of automobile locomotion has made the question of the coefficient of traction of the different tires used on the wheels of vehicles the order of the day. Opinions are as yet much divided, and it requires nothing less than direct and accurate experiments to solve the problem definitely and to show, without possible dispute in the future, the superiority of the pneumatic tire over that of iron and solid rubber.

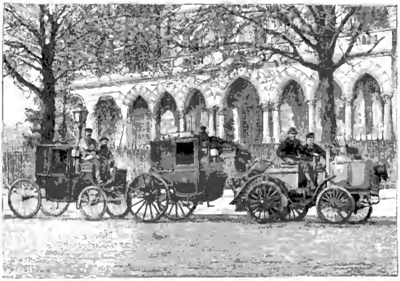
Some convincing experiments were made last year by M. Michelin, but the figures obtained were merely comparative and did not furnish numerical results capable of serving for the calculation of the power of motors to be placed upon horseless vehicles. The experiments have been recently resumed under more favorable conditions in the vicinity of Paris, by means of the singular train shown in Fig. 1. But, before describing the apparatus, a word as to the definition of the factors to be measured. As well known, in order that a vehicle may be hauled upon a road, which, in order to simplify the problem, we may suppose to be level, it is necessary that there shall be exerted a certain stress—a horizontal force, that depends upon the nature of the road, the weight of the vehicle, the nature of the tires and the suspension, rolling and speed of the vehicle. Such tractive force is measured in kilogrammes, and the ratio of such force in kilogrammes to the weight of the carriage hauled (likewise measured in kilogrammes) constitutes the coefficient of traction, which is generally expressed in kilogrammes per ton, or, more simply, in thousandths, with a view to avoiding the use of fractional numbers.

The experimental problem, therefore, consists in causing a carriage of known weight, whose wheels are provided with the tires to be studied, to be hauled over roads of varied character and in measuring the tractive stress exerted at every moment. From this is deduced the coefficient of traction by the simple calculation just mentioned.

In the experiments made by M. Fonvielle, under the direction of M. Michelin, a De Dion steam locomotive hauled the carriage through the intermedium of a registering dynamometer installed in a coach placed between the locomotive and the carriage hauled (Fig. 1).

The dynamometric coach belongs to the Compagnie Générale des Voitures. The dynamometer consists, in principle, of a double spring arranged transversely in the carriage. The middle of one of the bands is fixed to the carriage, and the middle of the other is attached directly to the vehicle to be hauled through an iron bar that traverses the coach. Under the tractive stress, the spring bends, opens, and leaves its position of equilibrium by a length proportional to the stress exerted.

If a pencil be placed vertically upon the movable part of the spring, and a band of paper be made to unwind transversely and with a uniform motion under the point of the pencil, the latter will trace a curve that will permit of determining the amount of the



Carriage under experiment. Dynamometric carriage. Locomotive.

FIG. 1.—DYNAMOMETRIC TRAIN USED IN DETERMINING THE COEFFICIENT OF TRACTION OF CARRIAGES.

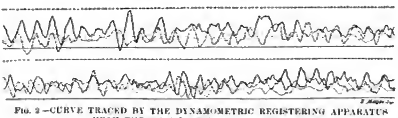


FIG. 2.—CURVE TRACED BY THE DYNAMOMETRIC REGISTERING APPARATUS UPON THE QUAI PRESIDENT CARNOT ROAD.

——, iron tires; — — —, solid rubber tires; ......, pneumatic tires.

stress at every instant, as well as the mean value of such stress upon a given length of roadway.

In order to determine the speed, another pencil bears against the paper continuously and is lifted for an instant, at every revolution of the wheel, through a mechanism actuated by the latter. It thus traces an interrupted line that permits of measuring the speed of the vehicle deduced from that of the unwinding of the paper, from the number of interruptions and from the length of the circumference of the wheel controlling the pencil.

The diagram in Fig. 2 shows the traces obtained with different tires (solid rubber, pneumatic and iron) at a speed of 22 kilometers (13 miles) an hour upon the old, dry and somewhat broken up macadamized Quai President Carnot road, at Suresnes. The experiments were made in replacing the wheels of the carriage and in equalizing their weight. It will be remarked that the curves relative to the pneumatic tires are not so high as and much more regular than those that correspond to the iron ones. The tractive stress is, therefore, more regular, and the shocks less perceptible with the pneumatic than with the solid rubber tire.

The mean values of the coefficients of traction deduced from these experiments, in integrating the results obtained upon runs of 1 kilometer (0·6 of a mile) are summed up in the following table:

CONDITIONS OF THE EXPERIMENT.

	Tires.		
	Iron.	Solid Rubber.	Pneumatic.
I. Boulevard de la Seine: (Level.)			
Good macadam, hard, dry and dusty.			
Wind ahead, v = 11·7 km. per hour	27·6	24·5	22·6
Wind behind, v = 11·7 " "	25·6	22·6	20·6
Wind ahead, v = 19·7 " "	34·4	29·9	24·8
Wind behind, v = 19·7 " "	27·6	23·2	23·8
Good macadam, hard and slightly muddy.			
v = 11 km. per hour	27·4	26·5	24·0
v = 20 " "	39·9	35·6	31·8
Good macadam, water soaked.			
v = 21 km. per hour	45·6	42·6	35·0
II. Boulevard de Versailles: (Grade of 40·1000.)			
Good macadam, hard, dry and dusty.			
v = 11 km. per hour	62·1	61·1	57·2
v = 19 " "	73·6	64·1	59·6
III. Route of St. Germain: (Grade of 6·1000.)			
Ordinary pavement, slightly rough and dry.			
v = 11 km. per hour	40·8	40·1	36·1
Ordinary pavement, slightly rough and with sticky mud.			
v = 18 km. per hour	54·9	57·6	44·0
Ordinary pavement, slightly rough and with half dry mud.			
v = 12·5 km. per hour	44·5	41·9	38·0
v = 20 " "	52·2	56·0	40·7
IV. Quai President Carnot: (Level.)			
Old macadam, somewhat broken up.			
v = 22 km. per hour	30·8	28·0	22·5

These figures bring clearly into relief the influence of speed as well as that of the wind upon the coefficient of traction. The superiority of the pneumatic over the iron tire, which is only 10 per cent. at a feeble speed and upon a good road, rises to 33 per cent. when the road is broken up and the speed reaches 22 kilometers an hour.

It may be said, without exaggeration, that the use of the pneumatic tire permits of a gain of from 20 to 25 per cent., on an average, upon the coefficient of traction, and, consequently, upon the power of the motor and consumption of fuel.

Such advantages are not to be disregarded, and although they have been recognized in principle by all competent specialists, we have to be thankful to M. André Michelin for having fixed the extent of their importance by accurate experiments and by means of registering apparatus of which the impartiality is beyond question.—E. Hospitalier, in La Nature.

SIX N. H. P. TRACTION ENGINE.

WE illustrate below an improved type of traction engine exhibited at the Bath and West and Southern Counties Agricultural Show by Messrs. Ruston, Proctor & Co., Limited, Lincoln, which possesses several novel features worthy of more than passing attention, particularly a single eccentric, reversing gear, illustrations of which are given in Figs. 1, 2, 3, and 4 herewith. The engine shown is particularly adapted for driving plowing tackle, thrashing and other machinery. It has a boiler of comparatively large capacity, the plates of which are of Siemens-Martin mild steel, and intended to withstand a working pressure of 120 pounds per square inch. The horn plates are of steel, riveted to the fire box and to each other, making a rigid frame, while the top of each plate is recessed to receive the

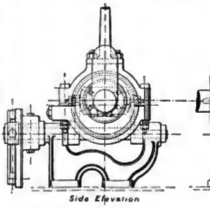


FIG. 1.

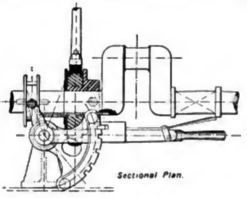


FIG. 2.

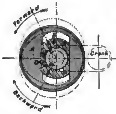


FIG. 3.

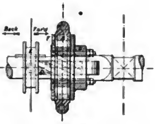


FIG. 4.


SIX N. H. P. TRACTION ENGINE.

crank shaft pedestals. The main portion of the single eccentric reversing gear consists of two moving pieces only, the eccentric, A—Figs. 3 and 4—which has an elongated slot cut centrally with the crank shaft and at right angles to the crank positions, made to fit and move freely on flats cut upon the boss of the main driving plate, C, and a sliding bar of steel securely fastened to the clutch, E, so that both may be moved easily in either direction parallel to the axis of the crank shaft. Upon the outer face of the bar, D, is formed a series of inclined teeth, which engage with similar spaces and teeth cut on one side of the slot in the eccentric, A. It will be clear that on moving the clutch, E, and bar, D, from side to side along the crank shaft, the eccentric will be made to rise and fall above and below its central position, as shown by the dotted lines in Fig. 3. The clutch, E, is driven by a feather key, upon which it slides freely, so that while it rotates with the crank shaft it can be easily pushed in and out by the clutch dies and reversing levers. The bar, D, in addition to being milled out at the back to fit the radius of the crank shaft, is fitted in a slot in the main driving plate, C, so that it is impossible for any twisting movement to occur which would cause a locking of the gear. A cover plate, F, is provided, and firmly secured by bolts passing through the main driving plate, C, so that the eccentric A, is held freely but firmly by the two plates, F and C, between which it rises and falls. It will be clear that the center of the eccentric is thus moved from the "forward" position, a, perpendicularly down the lap line, a, b, of the Zeuner diagram to b, which is the center of maximum throw for the "backward" motion. The effect of this movement is to vary both the travel and angle of advance of the eccentric. The chief factor in the success of this gear is the fact that while the rotation of the eccentric is easily performed by the large flat surfaces on the driving boss, C, none of the work of driving the valve is thrown upon the bar, D, which is thus free to move the eccentric and hold it in any required position with very little effort on the part of the driver.

We are indebted to The Engineer, of London, for the cuts and description.

HOW CLOTH IS DYED SEVERAL COLORS AT ONCE.

THE following methods of dyeing a piece of goods with several colors simultaneously are now largely used in Europe, according to the Textile World. All the methods are quite simple in theory, depending chiefly on the various absorptive powers of different fibers for different dyes.

There are but few dyes that tinge wool, silk, and cotton equally with the same preparation. The one or the other remains undyed, according to the kind of fiber and method, and may be dyed subsequently with another dye. . . . . The trifling quantity of dye mechanically precipitated upon the dyed fiber must be stripped first, however, but in such a manner that the color lake formed upon the dyed fiber is either not at all or at most very little attacked. A simple boil in condensed water or in a weak bath of acetate of ammonia suffices frequently.

Two-color half woolen weaves are generally produced in such a way that the wool is dyed first; the cotton is then mordanted with tannin and antimony, or antimony salt, and dyed with basic dyes from cold to warm. . . . .

Differences of temperature also influence frequently the fixation of a dye upon one of the fibers, and its indifferent behavior to the other. For instance, the so-called changeable effects upon piece-dyed gloria. These fabrics generally consist of woolen warp and silk filling, and both fibers are dyed in a different color, say the wool red, the silk green; wool garnet, silk blue, etc. The wool is dyed in a boiling bath; . . . the dye adhering to the silk is stripped by treating for thirty minutes with boiling water, and the silk is next dyed in a cold bath.

Still more curious effects can be produced when the different fibers have been treated, before weaving, with different chemicals.

As many mordant dyes furnish different colors according to the mordants used, it will become possible to produce in this way more than two colors. For instance, alizarine red gives a bordeaux upon chrome, a high red upon alum, and lilac upon iron. Consequently, by weaving together yarn treated with these three mordants, and dyeing the weave in an alazarine bath, a triple colored weave will be the result, and in case unmordanted yarn was also used, a fabric of four colors will be obtained. Again, the cotton dyer can, with different mordants, produce different shades of the same color. For instance, the tone of many colors dyed upon a sumac differs from that upon tannin-antimony, or antimony. Yarn treated with these two mordants and woven together with unmordanted, next dyed in two baths, gives a triple colored weave.

INDIAN INK MANUFACTURE.

AN interesting account of the manufacture of the so-called Indian ink, which is made only in the Anhui province of China, is given by Mr. Frazer, British consul at Wuhu, on the Yang tsze, in his last trade report. It is more correctly called China ink—encre de Chine—and from Anhui it goes to every part of China and all over the world. In 1895 about two tons of it, valued at £564, were exported from Shanghai to foreign countries. The materials with which this beautiful black ink is made are sesamum or colza oil, or the oil expressed from the poisonous seeds of a tree extensively cultivated in the Yang-tsze valley, and also well known in Japan. To this varnish and pork fat are added. The lampblack made by the combustion of these substances is classed according to the materials and the grade of fineness, and also according to the time taken over the process of combustion. The paste made of this lampblack has some glue added, and is beaten on wooden anvils with steel hammers. Two good hammerers can prepare in a day 80 pieces, each weighing half a pound. A certain quantity of musk of the musk deer or of Baroos camphor, for scenting, and gold leaves, varying from 20 to 100 to the pound, are added to give a metallic luster. The materials thus prepared are moulded in moulds of carved wood, dried, which takes about twenty days in fine weather, and adorned with Chinese characters in gilding. About 30 or 32 average-sized sticks of ink go to the pound. The price varies from 2s. or less per pound to as much as £7, there being over a dozen different grades. Nearly all writing is done by the natives throughout China, Japan, Korea, Tongking and Anam with this China ink, rubbed down on a stone ink slab and applied with a rabbit brush of sable, fox or rabbit hair, set in a bamboo holder, and, when not in use, carefully covered with a protecting brass cap. The superior kinds of this ink appear to be used in China and not exported.

PHOTOGRAPHY IN COLORS.

PROF. GRABY read a paper on photography in colors before the Académie des Sciences in Paris recently, and not only explained every detail of the process and gave the exact formula to be followed, but also showed some remarkable photographs in colors taken by himself.

In almost all the attempts made previously to reproduce color in photography the processes have depended upon the physical effects of the interference of light. Prof. Graby has depended entirely upon chemical action. His explanation of the process, as described in his paper, says the New York Sun, is as follows:

"When a plate of metallic silver is exposed in the dark to the action of chlorine, a series of chlorides is formed, ranging in color from yellow through red to blue. If the same plate be afterward exposed to light the action is reversed, the final result being yellowish white. If pure white silver chloride dipped in a bath of silver nitrate be subjected to feeble blue light, a blue subchloride will be produced which will retain a large proportion of the original chlorine. Similarly a red subchloride can be obtained, containing still less chlorine. The yellow is secured by a less direct method, for, although a grayish yellow subchloride of silver can be produced, it is not sufficiently pure in color or capable of giving all tints. Consequently chromic acid or a chromate is introduced, giving a golden yellow complementary to the blue violet of the silver, which is degraded by the light, furnishing all the yellows imaginable.

"Under the influence of blue light the blue subchloride is not sensitive, and remains the same, but the red, if mercuric chloride be present, takes up chlorine and is converted into the blue. If chromic acid be present also the yellow becomes oxidized to blue, so that only blue remains.

"Under yellow light the chromic acid is not effective, but the blue and red—especially the former—are bleached, losing their chlorine and amalgamating with mercury.

"Under red light, the red subchloride remains unchanged, but the blue is changed by the red orange rays into red subchloride.

"White light produces blue or greenish yellow, according to whether the paper is exposed in the dry or moist condition.

"To secure permanency, the yellow is fixed by washing the print with acetate of lead, which renders the chromate insoluble. The blue and red are obtained by introducing bichloride of mercury and salt into the coating of the paper. These two substances keep up a state of equilibrium as regards the action of light on the chlorine, so that the blue and red subchlorides retain their composition indefinitely. This fixing can only take place after the white has been fixed, except on salted and albumenized papers, to which, however, the subsequent method of fixing the white cannot be applied. Therefore complete fixation can only be secured with gelatine papers, and this is the most important point of the discovery.

"The trouble found for a long time was that the violet-blue silver compound produced by the action of white light could not be removed without seriously affecting the blue of the print. The first method tried was one in which the white light rendered the gelatine soluble, as in the perchloride of iron process. It was found that the gelatine became less soluble according to the color of the print. White light rendered the gelatine completely soluble, yellow light a little less so, red still a little less soluble and blue almost entirely insoluble. The gelatine in melting removed the chloride, which would have become blue, subsequently to fixation, on exposure to light. Thus, in the first method, the yellow was fixed with acetate of lead, the white by washing with warm water, and the red and blue by salt and bichloride of mercury.

"The first method could only be carried out with paper prepared as follows: Gelatino-chloride paper is allowed to become blue, almost to the violet stage, by immersing it in a bath of

Water	100
Hydrochloric acid	4

and exposing it to diffused light, then dipping it, when dry, into

Water	100
Bichromate of potash	1

"It is dried afresh and exposed anew until all the gelatine is just rendered insoluble. The paper is then ready to be sensitized for colors in the following bath:

Water	4	ounces.
Nitric acid	10	drops.
Mercuric nitrate	1	drachm.
Hydrochloric acid	1½	"
Sulphuric acid	½	"
Chromic acid	45	grains.
Soda alum	90	"

"This paper must be employed wet. The results so obtained are most interesting. But for practical work the paper prepared in the second manner should be used.

"In this method the light renders the gelatine insoluble, as in the carbon process. Gelatino-chloride paper is treated with acid and blued as above, then dipped in a bichromate bath, and then in nitrate of mercury. When dry, it is printed so as to reproduce the colors. After this it is treated with acetate of lead; then the image is transferred on to another paper and washed, as in the carbon process. Finally it is passed through a bath of bichloride of mercury and salt."

SELECTED FORMULÆ.

Keeping Flies off Stock.—Try one of the following:

(1.)	Carbolic acid	1	ounce.
	Oil of pennyroyal	2	"
	Spirit of camphor	2	"
	Oil tar	4	"
	Glycerine	2	"
	Fish oil	2	"
(2.)	Pine tar	1	part.
	Fish oil	2	"

The oil is used to keep the tar from sticking; if fish oil cannot be obtained, lard oil may be used. An addition of 2 ounces of crude carbolic acid to the gallon of paste will improve it. Paint the mixture on when necessary.

(3.)	Black oil	1	quart.
	Crude carbolic acid	4	ounces.
	Fish oil, enough to make	1	gallon.

—Pharmaceutical Era.

Preservative for Eggs.—Various preparations for preserving eggs for winter use are sold to unsophisticated housewives, and usually at a good profit for the manufacturer. The principle upon which most of such compounds act is that of excluding the air; almost any wax or varnish will serve this purpose. There are two requisites—have the eggs fresh and clean and put them up as late in the season as possible.

One very ancient and universally applied method consists in dipping the eggs into melted wax or paraffin. We append a formula for preparing a coating solution which duplicates one very extensively sold:

Gelatine	½	ounce.
Borax	⅛	"
Water, to make	10	"

Dissolve gelatine in the hot water in which the borax has been previously dissolved; bottle. If too stiff, warm the solution; rub on the eggs, or dip the eggs in the solution.—Bulletin of Pharmacy.

How to Make Potpourri.—The never failing delight of a rose (or potpourri) jar is known only to its fortunate possessor; yet it is so easy to prepare one, and, once prepared, so easy to keep it at the point of perfection, that the wonder is they are not more frequently enjoyed. The flowers should be gathered in the early morning, and tossed lightly on a table in a cool, airy place, to lie till the dew has evaporated; then put them in a large glass jar, sprinkling salt over ½ in. layers of the flowers. This can be added to from morning to morning till enough flowers for the purpose have been gathered, letting them stand in the jar for ten days after the last are put in, stirring the whole every morning. Have 1 oz. each of cloves and allspice, coarsely ground, and as much stick cinnamon, broken and shredded fine; transfer the flowers to another jar, and scatter the spices, mixed together, in layers; cover the jar tightly, and let it stand in a dark place for three weeks, when the stock will be ready for the permanent jar. Whatever this jar is, be sure it is provided with a double cover.

Have ready ¼ oz. of mace and ½ oz. of allspice and cloves, all coarsely ground—or pounded in a mortar—half of a grated nutmeg, ¼ oz. of cinnamon, broken in bits, 1 oz. of powdered orris root, and ½ lb. of dried lavender flowers. Mix these together in a bowl, and proceed to fill the rose jar with alternate layers of the "stock" and the mixture of spices, etc. A few drops each of several essential oils—rose, geranium, bitter almond and orange flower are good—should be dropped upon the layers as you progress, and over the whole pour 1 oz. of your favorite toilet water or eau de cologne. This is sufficient to fill two quart jars, or one very large one, and it will keep for years; from time to time various sweet things may be added to it, as a few tuberoses or a spray of heliotrope. If the jar be left open for a half hour every day, it will fill your rooms with a delicate, indefinable spicy fragrance, very refreshing and delightful, and unlike any other perfume. The flowers chosen should be those having agreeable perfume, roses, pinks, violets, verbena, heliotrope, acacia, balm, lavender, etc.

Photographic Hints and Formulas.—

From Liesegang's Photographischer Almanach.—(Amer. Photo. Jl.)

Toning Bath (sulphocyanate of ammonium).—Two solutions are to be prepared:

(a.)	Water	1	liter.
	Sulphocyanate of ammonium	30	grms.
	Hyposulphite of soda	5	"
(b.)	Water	200	c. cm.
	Chloride of gold	1	grm.

For use, pour 40 c. cm. of (b) into 200 c. cm. of (a). If in reversed order, the bath will be precipitated.

Combined Toning and Fixing Bath.—

Water	1	liter.
Hypo	175	grms.
Alum	20	"
Sulphocyanate of ammonium	10	"
Common salt	40	"

After a short time this solution becomes turbid; it is then to be left to settle for eight days, then decanted and filtered, then add:

Water	100	c. cm.
Chloride of gold	1	grm.

Mountant for Silver Prints.—

Gelatine	100	grms.

Swell in cold water, the superfluous water is then poured off and the gelatine dissolved by aid of a gentle heat. Then add with constant stirring:

Water	30	c. cm.
Alcohol	150	"
Glycerine	50	"
Carbolic acid	20	drops.

This permanent non-cockling mountant thickens in the cold. For use, the bottle or jar is to be placed in warm water, which liquefies the mass; it is then ready for use.

ENGINEERING NOTES.

Germany's highest bridge is over the Wupperthal, at Mungsten, near Remscheid, back of Elberfeld. It is 360 ft. high and 1,630 ft. long, the central arch having a span of 530 ft. The only higher bridge in Europe is the Garabit viaduct, 405 ft. high, in southern France. The Mungsten bridge was opened for railway traffic on July 1.

A new experimental locomotive is to be fitted up in the engineering laboratory of the Purdue University, the present engine, which has been six years in use, and has run the equivalent of 20,000 miles, being sent on to the road. The new engine, which, like its predecessor, is being built by the Schenectady Locomotive Works, will be arranged to work either compound or simple. Several sets of cylinders are to be provided, the largest being 30 in. in diameter.

The exports of steel rails, in tons, were as follows:

	1895.	1896.
United States	8,807	71,303
England	457,352	749,106
France	10,585	15,782
Germany	162,246	181,577
Belgium	86,452	97,572

It will be seen that the exports from the United States increased about eightfold in one year.—Centralblatt der Walzwerke.

A revolving observation tower is being erected at Great Yarmouth in honor of the Queen's Jubilee. The design comprises a strong hexagonal steel tower 150 ft. high by 14 ft. in diameter, surrounded by a circular structure or elevator. This elevator is raised and lowered by four strong cables, each of which is capable of performing the work alone. On this elevator is a circular platform fitted with rollers, and intended to revolve upon the elevator. This platform is provided with revolving chairs accommodating upward of 150 persons. While the elevator ascends and descends the tower the platform revolves around it, thus affording an uninterrupted and unsurpassed view of the surrounding country. The elevator is operated by powerful engines, and the platform is propelled by an electric motor.

A new balanced compound locomotive, which is the property of the Balanced Locomotive and Engineering Company, of New York City, has been received at Purdue University, where it is expected it will soon be tested on the locomotive testing plant of that institution. The tests will be conducted by Professor Goss, acting under the direction of Mr. George S. Morison, vice-president of the company. From the peculiarity of the design of many parts of this engine, the results of the tests will be awaited with much interest by railway men. This engine is of the ten-wheel Atlantic type. It is a four-cylinder compound, each cylinder being independently connected to the driving axle. No eccentrics are used, the valve mechanism being operated conjointly from the crosshead and crankpin. The firebox also is a departure from the ordinary design.

In order to obviate the freezing of the Baltic canal, thus keeping it open for navigation as long as possible, says Die Vedette, the authorities tried to replace the fresh water of the canal by salt water; this could only be done from the Bay of Kiel, where the water contains on an average 1¾ or 1⅞ per cent. of salt, while at the other end of the canal, in the Lower Elbe, the percentage is about one-half per cent. only, and the level there is far more affected by the tidal movement than in the Bay of Kiel. Now, by leaving open a sluice near Brunsbuttel during low tide, the salt water, entering from the Baltic end, was caused to gradually expel the fresh water through the other end of the canal, and at the present time, both in the canal itself and in the lakes through which it flows, the fresh water fauna and flora are more and more disappearing, and are being superseded by salt water plants and animals from the Baltic.

In an article in Timber, London, on the value of teak for structural and mechanical purposes, the claim is put forth that such wood is really the most durable timber known, and of special importance to shipbuilders, being very hard, yet light, easily worked, and, though porous, strong and lasting. It is soon seasoned, shrinks but little, and on account of its oily nature does not injure iron. In southeastern Asia it is not only considered the best material for ship construction, but for house carpentry and other work where strength and other lasting qualities are required. It is rarely attacked by ants of the white species, and its rare durability renders it specially valuable in a climate like that of India, where the elements causing decay are so numerous and powerful, where dampness brings on rapid decomposition, and where the white ant devours without scruple. In the operation of cutting this wood is frequently girdled one or two years before it is felled, and, thus exposed to the wind, the action of the sun, and to the pumping capacity of the leaves, it seasons rapidly, and is drier and lighter than timber felled green.

The transportation exhibit of the Transmississippi Exposition will have a novelty in the way of a miniature locomotive and train, said to be the smallest train in operation in the world, says the Railway Review. The engine weighs 450 lb., its nearest competitor being a London locomotive weighing 5,000. Its length, with tender, is but 6 ft. 7½ in., and the size of the cylinder 1¼ by 2½ in. The tiny drive wheels are but 8 in. in diameter and yet it hauls six observation cars, in each of which two children can be comfortably seated. These cars are 41 in. long and 14 in. wide, and covered after the fashion of the ordinary observation cars in the East. The entire train, consisting of engine, tender, four observation cars, one box car and a caboose, is but an even 29 ft. in length. The engine carries 6 gallons of water in the tender tank and 5 in the boiler, which will furnish steam for two hours. Coal is hauled and shoveled out of the tender on the same plan that it is on the larger engines. In fact, the little engine is complete in miniature in every detail. Instead of using oil in the headlight, a little electric battery in the engine under the cab seat furnishes an incandescent which sparkles from the pilot like the diamond in a hotel clerk's shirt front.

ELECTRICAL NOTES.

The total production of electricity at the Paris centrals on the first of October, 1896, amounted to 1,775,000 watts from the dynamos and 1,610,000 watts from the accumulators.—Electrotechnische Rundschau.

In the month of April the erection of the telephone line from Berlin to Budapest was begun. It is to be completed in September, the total cost being estimated at 290,000 gulden, i. e., about $120,000. Of the total length, 1,000 kilometers, 440 are on German territory.—Electrotechnische Rundschau.

A car propelled by current from an accumulator covered the distance from Ludwigshafen to Frankenthal (Germany) at a rate of 50 kilometers, i. e., about 31 miles per hour. The car was an ordinary third class carriage in which the necessary arrangements had been made for electric propulsion.—Uhland's Wochenschrift.

The following extract from the Telephone Tariff at Stuttgart may interest our readers: Within the town limits, for a five minutes' conversation, 2½ cents; beyond these bounds, for the same time, 6 cents. The yearly subscription for one telephone line is $25 for distances less than three kilometers, and $6.25 extra for every two kilometers in addition.—Electrotechnische Rundschau.

An electric contribution box is the latest Connecticut invention, says the New York Tribune. The minister touches a button, and small silver cars, lined with velvet, visit each pew simultaneously, running on a slender rail back of each pew. Each car returns to a lock box at the pew entrance, and the deacons collect the receipts after the service. We cannot vouch for the item, however.

The electric tramway at Lausanne, Switzerland, is interesting in this respect that it runs up the steepest incline that is surmounted by any train or train depending on adhesion to the rails. The way from Place de la Riponne to La Ponthaise at one spot rises by 11·3 per cent. and in another by 8·2 per cent. The cars run at 6 kilometers per hour, and on one occasion a velocity of 12 to 13 kilometers per hour was reached.—Uhland's Wochenschrift.

The recently established electrical tramways in Cairo are a great success, and, notwithstanding the very low rates, which are sometimes less than two cents for a distance of three miles, they are being worked at a profit. The electric lighting is also being extended, and on account of the numerous overhead wires which are spreading in all directions, the government propose to issue rules which will have to be adhered to in all future installations.

The gold mines in Transvaal are supplied with electricity at a pressure of about 250 to 500 volts. Some of the mines are 20 to 25 miles from the dynamos, the force being transmitted by overhead lines. Every precaution is taken to provide against accidents. The voltage is reduced to the required level of about 190 volts by transformers. The total horse power transmitted is about 2,100; the charge is £45 per annum per horse power, i. e., much less than the cost of steam.—Electrotechnische Rundschau.

On the 31st of March of the current year a stock company was formed at Batavia (island of Java) for the construction and operation of an electric tramway system there. The capital amounts to 1,600,000 florins, i. e., about $800,000. The contract for building has been made with a German company. Two single track lines are first to be laid of together about 15½ kilometers length. On these there is to be one car for coolies and one for Europeans every ten minutes. According to the contract, the line is to be opened for traffic in May of next year.—Electrotechnische Rundschau.

A new method of obtaining light through the medium of electricity has recently been described by O. Schutt, of Germany. A spark from an induction coil is passed through a thin (capillary) tube, into the ends of which electrodes of copper or aluminum are inserted. The light produced is very brilliant, exceeding in this respect the light of the arc lamp. A great drawback is that the tubes wear out very rapidly, especially if very narrow; wider tubes give less intense light, and so do tubes from which the air has been partly exhausted. Owing to this rapid deterioration of the tubes, the discovery seems to have no practical value.—Uhland's Wochenschrift.

Perhaps in no other branch of technical industry is the use of electricity as a mechanical power so advantageous as in mining. In collieries the work is often carried on in many places, considerable distances apart, and no force can be so readily transmitted as electricity. Besides, in many cases, mountain rivers supply cheaply the required force for the production of electricity. In Europe and America, rock drilling, exploding, the transport of material, the pumping, ventilating and lighting of the plant, are done by such means. And recently the firm of Siemens & Halske, of Berlin, have laid a complete plant of this character in Tokio, Japan, and also in the Transvaal a similar one is in preparation, where four dynamo machines will work with a total horse power of 4,000; the current will be partly transmitted as far as twenty-eight miles.

More than twenty English railway companies have adopted a system of lighting the carriages by electricity, such that each van is quite independent of the rest of the train. On every carriage there is a dynamo and a storage battery so arranged that when one is at work the other is at rest. The dynamo is driven from the axle of the carriage, and is constructed so that the current is automatically kept uniform. At speeds less than 20 kilometers per hour the dynamo is at rest, and the storage battery only supplies the electricity. The conductor can switch off either one-half of the lamps or all. Each carriage has two lamps, in the first and second class carriages of 8 candle power each, in the third class carriages of 5 each. The additional weight of each apparatus is 4½ cwt.; the cost of installation, $250 per carriage.—Electrotechnische Rundschau.

MISCELLANEOUS NOTES.

The number of Hungarian patents issued in 1895 was 3,191. Hungarians received 615 patents, Germans 1,377, Austrians 656, Englishmen 144, Americans 136, and Frenchmen 128.—La Propriété Industrielle.

Among 1957 patents granted in Switzerland in 1896, only 603 were issued to Swiss citizens, Germans coming first with 689 patents. Frenchmen obtained 214 patents, Englishmen 131, Americans 92, and Austrians 80.—La Propriété Industrielle.

Attempts to free rancid cocoa fat from its unsavory constituents have successfully been made at Thann, in Alsace. The patented process consists in acting on the best cocoa fat with overheated steam, and then allowing it to cool hermetically cut off from contact with air, after the volatile products of the action are driven off.—Prometheus.

In Russia cotton spinning is the most important industry. In 1843 there were 3,500 spindles, each of which supplied some 33 pounds of cotton a year; now there are 5,000,000, and each produces more than double the amount formerly given. The material is supplied from the Caucasian Mountains and Asiatic Russia.—Uhland's Wochenschrift.

The name meerschaum, it appears, is derived from the word myrshen, which was used to designate the mineral at Brussa, in Asia Minor, where it used to be found plentifully. Meerschaum is a product of the decomposition of serpentine. It is, originally, a soft, claylike gray mass, which hardens to the well known white solid. Chemically, its composition is represented by the formula $Mg_2Si_3O_8.2H_2O$.—Prometheus.

There has been a considerable increase of stock companies in Germany, their number being at the present day 3,300. Of these 362 are banks, 127 insurance companies, 430 of the remainder are devoted to traffic and transportation. Foundries, mines and salt mines provide another 280 companies, and quarries 201. Porcelain manufacture is mostly private property, so only 13 companies of this branch exist.—Uhland's Wochenschrift.

For the measurement of very low temperatures, electricity is now usually called to aid. But if for any reason it is desired to use a fluid thermometer, which is to be practicable at the boiling point of atmospheric air (− 190° C.), the fluid best suitable is a mixture of hydrocarbons known as petroleum ether. This substance shows a remarkably strong contraction on cooling, at − 188° C. its volume is ⅘ of that at 0° C. and ⅔ of that at + 30°.—Stahl und Eisen.

Italy alone, to the present time, has adopted the 24 hour system for designating the time of the day. In Belgium it was to be introduced on the 1st of May, both for railways and for mail and shipping service. So far, the system seems to have met with little favor in Germany, but it is expected that there, too, a change will take place before very long. In France steps have been taken in that direction, and Switzerland is to adopt the new reckoning on May 1, 1898.—Uhland's Wochenschrift.

The province of Norrland, Sweden, which occupies nearly one-quarter of the whole realm, besides being covered with immense forests, is extremely rich in iron ores, which are as yet scarcely touched. The importance of these north Swedish mines is greatly increased by the fact that it is expected the iron ore of other origin which has come to the market plenteously so far will continue to do so for twenty years more only. After that time, the working of the Swedish mines may become a matter of necessity.—Uhland's Wochenschrift.

In spite of all efforts to increase the consumption of domestic coal in Germany, the importation of English coal is continually growing, being better and cheaper than any Continental produce. In 1895 England sent to Germany 80,000,000 cwt.; in 1896, 86,000,000. Of the additional 6,000,000 cwt., by far the greater part was burnt in Berlin. In the first two months of the current year the importation of English coal has gone back a little by some 800,000 cwt. In France, also, the importation of English coal has increased considerably.—Uhland's Wochenschrift.

A postal oddity is reported from Hanover. A merchant wished to send some circulars to a German customer in the form of cardboard rolls, and was greatly disgusted to find that they were rejected as printed matter, because their length exceeded the limit for German inland postage—45 centimeters. By parcel post they would have cost him some $625. But a way out of the difficulty was found. It appeared that the rules of the international postal union permitted a length of 75 centimeters. So the circulars were sent to Holland by express, and were then sent on from there at 4 cents apiece.—Uhland's Wochenschrift.

A new process for dyeing skins by the aid of electricity is described as follows: The skins to be treated are laid out on a zinc table, which serves as positive pole. Then the color which is desired to be imparted to them is poured on and is connected to the negative pole. The current passes and causes the color to pervade the skins. The process can also be modified and employed to trace designs on the surface by admitting the current (from the negative pole) by a copper plate which has been cut out in the design required. The parts covered by the plate show lighter coloring than the others, when the process is completed.—Prometheus.

A considerable amount of raw sugar used to be exported from Germany to England, where it was refined, and then further transported to the United States. Of late the export from England westward has decreased; the consequence being that more sugar has been exported to the United States from Germany and less to England. The exports from Germany to England, in 1892–96, are given below:

	Raw sugar.	Refined sugar.
1896	2,010,792	3,050,176
1895	3,156,401	3,231,814
1894	2,631,787	2,456,307
1893	2,519,147	2,106,625
1892	2,450,358	1,760,368

—Uhland's Wochenschrift.

THE ENGLISH MISSION TO HARRAR.

THE English mission, composed of Mr. Rennell Rodd, ambassador of the Queen of England, Colonel Wingate, attache of the Egyptian government, Count Gleichen, a relative of the Queen and attache of the minister of war, Lieutenant Cecil, Captain of the Horse Guard Bingham, Captain of the Engineers Swayne, representing the Indies, and Interpreter Speedy, made its entry into Harrar on the second of April, at half past nine o'clock. An escort of Indian lancers preceded and closed the procession. These lancers, of the garrison of Aden, were selected on account of their tall stature. The procession traversed the city between a row of Abyssinian soldiers.

After the official receptions a collation was served, and the mission, which had declined the offer of hospitality of Ras Makonnen, proceeded to establish its camp outside of the gate of Choa, at about half a mile from the city.

On the next day (April 3) Ras Makonnen visited the English camp and had a few minutes' conference with the different members. The mission returned the Ras' visit during the day, and continued its visits in beginning with the venerable French prelate, Mgr. Chauvin, Bishop of Harrar, and ending with one to the Russian mission of the Red Cross.

On the 4th of April the English mission assisted at the divine service of the Coptic rite, a ceremony at which likewise were present Ras Makonnen and Colonel de Maximoff, head of the Russian Red Cross mission.

A curious incident occurred at the moment at which the clergy presented the crucifix to be kissed by those present, and there was an instant of hesitation among the officiants when it became a question of presenting it to the English mission, which, according to the belief of the Abyssinians, was not composed of Christians. It became necessary to parley with the Ras, who gave orders to present the cross to it. The members of the mission kissed it devotedly, to the great astonishment of the assembled Abyssinians.

The mission now made its preparations for departure. It seemed to desire to hasten the moment of starting as much as possible, since the presence of Ras Makonnen inquieted it.

Upon the whole, it was an embassy and reception of politeness. As far as politics is concerned, the character of the Abyssinians is too well known to us to allow us to believe for an instant that they will lay aside the reserve that they have been able to preserve up to the present toward all the civilized nations that have thought it their duty to enter into relations with them.

Emperor Menelik II will doubtless receive Queen Victoria's ambassador handsomely, and will lend himself to all the exigences of the Abyssinian protocol in order to listen to explanations of the avowed purpose of the mission, and will reserve his reply. This will be a burial of the first part of the question, and everything will re-enter the primitive order after much ink has been spilled and much powder wasted on joyous salutes. Persuasion will have no more influence than threats upon the negro, who now feels himself strong enough to refuse to have any further discussion about anything that touches the independence of his people and the total integrity of his territory.

We present herewith a copy of a photograph of Serkis-Terzian sent on by M. Bavelaer, the explorer, now on a mission to Harrar. As this former Abyssinian chief played an important part in forcing the submission of Harrar to Menelik, the following notes concerning him will prove of interest in connection with the subject under consideration:

Serkis-Terzian, a native of Armenia, and endowed with an extremely adventurous character, went, when very young, to Abyssinia and entered the army of that country.

After traveling over Abyssinia in all directions, our hero finally stationed himself at Harrar during the year 1883 and witnessed the evacuation of this country by the Egyptians in 1885.

RAS MAKONNEN AWAITING THE ARRIVAL OF THE ENGLISH MISSION UPON THE SUMMIT OF AOU ISSIN.

At the time of the accession of Abdulley, emir of Harrar, the fact that he was a Christian submitted him to all the vexations of that tyrant and of Mussulman fanaticism, and it was with a feeling of unrestrained joy that he learned of the Choans' preparation for war.

After the defeat of Abdulley's troops by King Menelik II and the flight of the emir to Berbera, the truly active role of our adventurer began. Deputizing him with other notable men of Harrar to bring to him the submission of that city, Menelik confided to him the mission of taking possession of the latter in his name.

Followed by twenty resolute, picked men, he, without striking a blow, entered the city in which, but a few hours before, he had been treated as a pariah and constantly menaced with death.

After putting guards at the gates and disarming the latter's defenders, he placed small detachments in the different public buildings. The day following this exploit Menelik made a solemn entry into Harrar.

The king made a gift to Serkis of the territories of Noie and Cambodia and of the tributes that he received therefrom, and then took him to his court. A few months later he was appointed governor of Ginel-deissa, a very dangerous post at the epoch and one dreaded by the Abyssinians. Through a regime of terror and numerous expeditions he was enabled to submit the Somalis to the authority of the king, and extended the conquest of these territories as far as to Bijo Caboba. It was upon his return from one of these expeditions that the photograph reproduced herewith was taken.

Finally, tiring of this life of adventure, which would

RAS MAKONNEN ON HIS WAY TO THE PALACE TO AWAIT THE ENGLISH MISSION, ABYSSINIA.

delight a writer of romances, Serkis retired to Harrar in order to devote himself to commerce. It was through the intermedium of him in great part that Menelik's army was provided with the first rapid fire guns that permitted this monarch to extend his authority and assume the independence of his states.

Serkis is still carrying on the business of selling arms, to which he has added a well stocked bazar, the management of which he has confided to his brothers, whom his new fortune has enabled him to call to his assistance.†

At the time of the Armenian massacres he brought to Harrar, at his own expense, several Armenian families that had escaped the butchery, and also sent aid to the Armenian committee.

His repose seems to weigh upon him, however, and the adventurer is seen to awaken in him when, with legitimate pride, he is recounting to some one the number of his legendary exploits.

The fact that his life has often been threatened and that a price was once set upon his head by the English has robbed him of none of his somewhat savage joviality.—Le Monde Illustré.

THE FUTURE OF CENTRAL AMERICA.

By JOHN RICE CHANDLER, in the Iron Age.

FEW Americans realize that the shores of the several republics which constitute Central America are but an easy two or three days' steaming from our coasts. In fact, the everyday fruit steamers running between Puerto Barrios (Guatemala), Puerto Cortez (Honduras), Bluefields (Nicaragua) and Limon (Costa Rica), usually make the trip to New Orleans and Mobile in from four to five days and to New York in five to six.

If two other points were clearly understood—the climatic conditions and the so-called revolutions—a much larger proportion of our people would visit these republics, and, incidentally, good will and commerce would be enormously increased to mutual advantage.

As to the climate. That backbone of the country, the Andean chain, has determined the question of elevation, therefore of temperature. Although the whole land is within the tropics, all the central plateaus have an elevation of 2,500 to 6,000 ft., with a mild, temperate climate. The coasts, and the coasts only, as might have been expected, are hot and sultry, and in some places unhealthy. All the cities and large towns are located, with few exceptions, in the temperate regions.

With regard to uprisings. These republics for over fifty years were continually in the throes of revolution. Some twenty years ago things reached a crisis, and the people at large seem to have become convinced that nothing but ruin and death was to be obtained by the methods till then pursued. Since then uprisings have taken place, but they have seldom lasted over a few weeks, and, but for a few sensational correspondents, never resulted in any particular harm to life or property.

As year after year has gone by and the Central Americans have been placed in closer contact with the outside world, they have developed a great desire for advancement in every line of life, and have shown this practically by the rapidity with which they have come into line with modern nations. The telegraph, telephone, electric light and steam railways are all to be found in ordinary use in each and all of the five republics. Modern machinery is found in the factories, the sugar, coffee and tobacco plantations. In fact, except among the lowest stratum, the people have the ways and manners, the amusements and ambitions of Europeans.

So far, foreign immigration has been slow to appreciate the favorable conditions presented by these countries, but now that such countries as the Argentine Republic, Brazil and Uruguay are relatively well supplied with foreign population, Europe is looking toward Central America as a future receiver of her surplus population. And well they may, for eight-tenths of the land is temperate in climate, and no more valuable crops can be obtained in any country.

Although large tracts of land are already taken up with the cultivation of sugar, cacao, tobacco, rubber and coffee (the latter alone producing a yearly crop valued at upward of $40,000,000), there are still hundreds of thousands of acres of land waiting to be put under cultivation, just as good in every way as that now producing. Most of the East Indian spices and medicinal plants could easily be grown in these republics, with the result that, like our coffee and cacao, the finest grades and best prices would be obtained. Another source of wealth is tobacco; it is grown successfully in the sheltered sections of Zacapa and Cojutepeque, as well as in Honduras, but with careful cultivation, selection, and last, but not least, capital, a product in nearly every way equal to the Cuban weed could be produced in large quantities and on virgin soil. That is a thing which to-day is impossible in Cuba.

Capital would immediately bring more railroads. At present there are nine lines running or in construction, but the interior of all these five countries remains to be opened up. When the Guatemala Interoceanic and the Costa Rica Railroad from the Atlantic to the Pacific are finished, a great impetus to commerce will surely have been given, but these republics will still be quite as far from one another as they are to-day. A series of branch lines will be needed to ramify through the rich sections of the interior, and then a north and south line running from the Mexican border and tapping their railroad system at or near Tapachula; following the Pacific coast line, this railroad (already surveyed by order of the United States government) would traverse Guatemala, Salvador, a part of Honduras, Nicaragua and Costa Rica, finally joining the South American railway system at Panama.

Not only would such a line have great value from a commercial point of view, but it would be equally important from a political one. The interests of the five sections of Central America are naturally in the direction of political union. Their language (Spanish), customs, ideas, and traditions, constitutions and general laws, are the same, or at least very similar, throughout. What is most needed at present is frequent and rapid intercommunication from Guatemala on the north to Costa Rica on the south. This is the only way to bring about a universal feeling and desire among the masses for union. The experiment in this direction, now being made by Nicaragua, Honduras and Salvador, is certainly very laudable, but the people do not seem to take "La Republica Mayor," which they have formed, very seriously as yet. The sections are still too far away from one another to feel the benefit of such a union. But little can be done in this direction as long as it takes fifteen or even twenty days to travel from one section of the country to the other, as is now the case. Notwithstanding, the union of the five republics under the Central American flag is bound to come. The better classes are beginning to see the great advantage of running one government instead of five, with all the attendant expense. Furthermore, they see clearly that a country with upward of four million inhabitants would have greater respect shown it by the rest of the world than under the present arrangement. They clearly understand that a new country, with a stable, honest government, rich in raw material and already producing large crops of the most valuable staples, would have many more chances of attracting American and European capital as well as immigration of the better elements.

The Central Americans point with pride to their splendidly appointed coffee and sugar plantations, equipped with the very latest types of machinery, whether for drying, cleaning and hulling coffee or mills and pans for sugar.

All this is not a circumstance to what the number, size and equipment of plantations will be, once the republic of Central America is erected on a solid basis and Americans realize that they have such a land of promise but a couple of days' sail from their own shores.

Perhaps one of the most important, if not the greatest element in the bringing about of favorable conditions in these republics, is the building of the Nicaragua Canal by Americans. The real patriots among the Central Americans see that it needs the moral and financial backing of a great and friendly power to push such a gigantic work to a successful end. They, therefore, prefer a partnership with the leading republic of the world to any inducements held out to them by European monarchies. To those who still have doubts as to the great commercial value of the canal the perusal of the statistics got up by the British to show the trade and estimated traffic through the canal is recommended. The tonnage from the United States to Asia and the Pacific coast of Spanish America is placed at 1,300,000; that between American and South American ports and Europe, 500,000 tons; trade between Europe, Asia and Australia, 2,000,000 tons. Among other reasons that might be put forward to show American capitalists, manufacturers and merchants that the present is the very best time to interest themselves in Central America, notwithstanding the depression caused by the fluctuation in silver prices, is the one that, in contrast to several South American countries, business is not yet overdone; openings in nearly every line can be made with moderate capital to yield handsome profits. Of course, it stands to reason that such rich territory will not long go begging, once the world is fully alive to the fact that life and property are as safe there as in almost any other part of the world.

SERKIS-TERZIAN, EX-GOVERNOR OF GUELDEISSA.

HOW TO AVOID TAKING COLD.

THE fin de siècle toilet is not complete without rinsing the mouth and spraying the nasal passages and the throat with an antiseptic solution night and morning. By these means the upper air passages are kept in an antiseptic condition, unfavorable to the development of germs, and disease is prevented. G. Lemoine, in the Nord Med. (Jour. Am. Med. Assoc.), states that numbers of persons by these simple precautions have passed through the winter and rainy spring without once catching cold, although they had previously been extremely sensitive, and troubled with severe colds much of the time. He recommends to rinse the mouth with a glassful of fifty grammes Labarraque's solution mixed with one liter of water, or the following: Thymol, 0·50 gramme; alcohol, 20 grammes; water, 1 liter. With an ordinary toilet atomizer the nasal passages and upper part of the throat should be thoroughly sprayed with some solution like the following: Phenol-salyl, 0·50 gramme; chlorid of sodium, 3 grammes; distilled boiled water, 500 grammes. He adds that the teeth should be well brushed, and the fingers never put in the mouth or nose. A few menthol drops should be carried in the pocket and dissolved in the mouth occasionally. He concludes with the remark that a friend of his has always succeeded in breaking up a cold in the early stages, by taking during the first day four to six capsules or pills of essence of turpentine in addition

to the rinsing or gargling and spray, with a glass of purgative water the next day, followed in a few hours by 0·50 centigramme of quinine.

THE SURGICAL STATUS OF THE BICYCLE.

FOR twenty-five weeks during the wheeling season, the Buffalo Express has collected statistics of accidents occurring to bicycle riders in the streets of that city. Before quoting figures, some preliminary remarks may be in order to call attention to their general significance.

Cold blooded as it may seem, it is necessary for the surgeon, like the physician of any branch of practice, or like the man engaged in business of whatever kind, to inform himself as to the sources of his employment. It is not simply with regard to the fullness of his pocket book that the obstetrician notes the average number of births to each marriage, or that the surgeon is interested in the influence of steam railroads or of trolleys on his practice. As a matter of practical philanthropy, it is desirable that every one should anticipate, so far as possible, the demands which are likely to be made upon him, while sociologic questions are solved only as each worker notes the influence which the various institutions of civilized life have upon the welfare and detriment of the human race, so far as his own possibilities of observation extend.

The statistics gathered by the Buffalo Express ought to be fairly representative. The city is one of the second magnitude, having—exclusive of suburbs—about 350,000 inhabitants. One in seven of these, or about one in four, who may be expected to use the highways, ride bicycles, to some extent. Although supplied with over two hundred miles of smooth pavement, the majority of the riding, both by men and women, is for business and therefore on downtown streets. These are not so wide nor so empty as might be desired by cyclists, still there is no such crowding as occurs in New York and Boston, none of the tortuous and narrow streets of the latter and none of the bad pavements which still linger in Philadelphia. On the whole, the conditions are as favorable as can well be expected without being ideal.

The Express has chronicled, between April 15 and October 10, sixty-three bicycle accidents serious enough to involve medical attendance. The editorial writer also states that he personally knows of a number of cases that did not get into print and estimates the total number of accidents as about one hundred, or four per week. No deaths have resulted, although many of the injuries were, at first, thought to be fatal. The distribution of these accidents, so far as time is concerned, is about equal for May, June, August and the parts of April and October covered by the statistics. Five accidents occurred in July and sixteen in September. The increase for September is correctly ascribed to the greater amount of traffic. The minimum for July was probably due in part to the diminution of business, the absence of wheelmen from town and the relatively greater use of uptown and suburban streets. The Express explains an increase of accidents in May and June as probably due to the large number of novices riding, but the figures given do not show any such increase. Forty-one, about two-thirds of the cyclists injured, were men, indicating a relatively greater liability on the part of women. This is explained, not only by differences in dress and general physical development, which work to the detriment of the female sex, but by the common observation that women cyclists carry more bundles than men, and, therefore, have their wheels under less perfect control, and that they also take chances that none but the most reckless male riders would dare.

These statistics show in the most convincing manner that the popular notion as to the prevalent carelessness of cyclists is totally wrong. Only six serious accidents to pedestrians can be charged against 50,000 wheels in half a year, and it is more than possible that some of these six may have been partly, or wholly, due to carelessness of the injured persons. Moreover, of the sixty-three injured bicyclers, only five had suffered from collision with other cyclists, representing, probably, not more than three serious accidents, since apparently the figures refer to the number of injured persons and not to the number of collisions. In other words, these 50,000 cyclists, riding for half a year—and the half during which wheels are most used—threading their way in and out through crowded streets, sometimes in such swarms that one might count a hundred or two in walking a block, are responsible for only about ten collisions with serious results. Four riders collided with trolley cars and one or two each with telegraph and telephone poles, trolley posts, curb stones, lamp and sign posts, etc.

In contrast with these meager figures, we learn that twenty-five of the injured bicyclers had collided with vehicles drawn by horses. The figures lend color to the general opinion of wheelmen that many drivers of delivery wagons, moving vans and hacks not only do not do their share in trying to avoid collisions, but take a malicious pleasure in cramping suddenly on the wheelman or otherwise blocking him and letting him avoid disaster—if he can. Many of those who are not malicious are criminally careless.

It should also be noted that, in all probability, many of the cases in which bicyclers have run into poles and curbs are directly due to crowding by vehicles. In one such case—whether included in the list or not, we do not know—a wheelman was deliberately crowded to the curb by a hack driver and fell, sustaining a compound fracture of the leg.

We are not aware that there is any characteristic injury resulting from bicycle accidents. The rider is supported by feet, perineum and hands, so that no one part of the body suffers the entire force of impact. The direction of the collision, the rate of speed, the objects against which the wheelman falls, or against which he may be driven, his attitude on the wheel, all influence the lesion which he may suffer. It must be borne in mind, also, that a cyclist does not suffer one fall unless he is precipitated over an embankment or has some similar accident, but is pushed sideways by his momentum, after he strikes the ground, without being able to free himself from his wheel or to stand upright. Thus, he may sustain injuries to his knees, hands, shoulders or head, according to his efforts to save himself and according to the direction in which he stumbles. Those who do not ride bicycles, almost without exception, overlook the fact that the cyclist not only suffers the force of collision, but also the results of this pushing, stumbling fall.

The pedestrian often imagines that it is sport for the wheelman to run him down, and the comic papers have a large file of jokes to this general effect. The pedestrian, already on the ground, is struck by an air cushion, or is whirled out of the way by the fork or handle bar. The wheelman, on the other hand, bears the brunt of the collision on the perineum, and also receives a bad fall.

Much has been written on the dangers of wheeling, medical and traumatic, but we believe that actual statistics, as to the result of street accidents, are rare.—The Medical and Surgical Reporter.

REMARKABLE EXPLORATIONS IN BABYLONIA.

A CORRESPONDENT of the Times says that Mr. Haynes, who for nearly five years has been in charge of the American expedition excavating the great mounds of Nuffar, in Northern Babylonia, has unearthed the ruins of the oldest city in the world, the foundations of which were laid some six or seven thousand years before the Christian era.

The work was begun in 1888 by the University of Pennsylvania, the funds being provided by a small committee. The expeditions of 1888–90, under the direction of Dr. Peters, produced a harvest of about 10,000 tablets and inscribed objects, among them several records of Sargon I and his son Naram-Sin, whose date B. C. 3800 was by many regarded as the starting point of Babylonian history. Troubles among the Arabs and the usual difficulties with the Porte delayed the work for three years. In 1893 the explorations were renewed under the charge of Mr J. H. Haynes, and they have been carried on continuously ever since, and have produced results such as were never dreamt of even by the most ardent advocate of Babylonian explorations, and the history of civilization has been carried back to an antiquity never thought of. The methods of systematic research such as were employed by Curtius, Schliemann and Petrie, laying bare stratum after stratum of the ruined city, noting with care the position of every object, and above all the aid of photography, had never been applied until now. By this method the history of the excavated city may be read like a book, each stratum as it is uncovered furnishing us with a chapter of its long lost history. The story of Nippur as read in its ruins is indeed a remarkable one.

The great mounds of Nuffar are situated on the east bank of the now dry Shat-en-Nil, a great main artery navigation canal which once connected Babylon with the Persian Gulf. The central feature of the ruins is a vast conical mound, called by the Arabs Bint el Amir, "the Amir's daughter," which rises to a height of nearly 29 meters above the surrounding plain. This mound marks the site of the great ziggurat or temple stage tower first built by Ur-Gur, or Ur-Bahu, as he was formerly called, about B. C. 2800, and subsequently repaired and added to by later kings. This vast structure was the central point of the explorations by Mr. Haynes.

The arrangement of this temple and tower of Ur-Gur bears a most striking resemblance to the early Egyptian pyramids. At no period in early Chaldean history was there so close a contact between Egypt and Chaldea as during the dynasty of Ur-Gur Dungi and Gudea of Lagash. These rulers, as we know from their numerous inscriptions found at Tello by M. de Sarzec, were in constant communication with Egypt by sea and through the Sinaitic peninsula. It was from this region that they obtained the hard diorite and porphyry for their statues and door sockets. The statue of Gudea, seated and holding the plan of a temple on his knees, is most Egyptian in character, the attitude resembling that of statues of Khafra and Menkara; moreover, the scale engraved upon the tablet gives the Egyptian and not Chaldean cubit. The tower rests upon a massive platform of crude brick. Excavations conducted below this revealed the existence of a second pavement of much finer construction, being built of kiln-burnt bricks of great size—the dimensions being 50 cm. square and of great thickness. Nearly the whole of these bricks were inscribed, and bore the stamps of Sargon I and Naram-Sin, his son, and its date, therefore, is just a thousand years prior to the buildings of Ur-Gur—namely, B. C. 3800. From the inscriptions of both these kings we know that they both built large portions of an older temple of Mullil.

Northwest of the temple was a line of mounds marking a rampart, and Mr. Haynes in 1895 cleared a portion of it and unearthed one of the most extraordinary pieces of masonry ever discovered. The foundation consisted of a solid bed of clay mixed with straw and puddled down, resembling some of the constructions found by Dr. Schliemann at Hissarlik. Upon this foundation and plinth was constructed a solid brick wall, 52 feet in thickness and rising to an unknown height. The builder of this wall was Naram-Sin, whom so many have regarded as a mythical king. It is probable that this rampart formed also a broad roadway round the city, and it may possibly, as Mr. Haynes suggests, have had a row of chambers in its upper part. Directly southeast of the great tower and close to the great rampart Mr. Haynes discovered a chamber with no doorway—it was evidently a vault entered from above, and was built by Ur-Gur. This and a second chamber immediately below it were the archive chambers of the temple, which had been partly restored by Ur-Gur, while the second was that of the king, built up to the level of his own pavement.

It is clear that at some time between the time of Ur-Gur, B. C. 2800, and the rise of the Kassite dynasty, B. C. 2200, the archive chamber had been broken into and large numbers of objects carried away and the rest broken and scattered. There can be little doubt that this disaster took place during the terrible Elamite invasion in B. C. 2285, when all the principal temples were pillaged and their treasures carried to the Elamite capital. We have proof of this afforded by a small disk of agate found in the ruins, which bears on one side a dedication by Dungi to Mullil, and on the other a dedication by Barnaburyas, B. C. 1400, which states that it was taken from "the palace of Susa in the land of Elam." The amount of debris from the pavement of Naram-Sin to the top of the mound is 11 meters in height, and this, we know, took close on 4,000 years to accumulate. Mr. Haynes, encouraged by the success of his work in the upper stratum, proceeded to excavate to reach the virgin soil, which he did at the depth of 9·35 meters, passing through the debris of ruined buildings, accumulations of broken pottery, and fragments of inscribed stone objects and well constructed drains. These remains prove the existence of at least two temples below the pavement of Naram-Sin, which at the most rapid rate of debris accumulation cannot be assigned to a later date than between six and seven thousand years before the Christian era. This lowest stratum has been much disturbed and the buildings pillaged; still, sufficient remains to reveal to us earlier phases of Babylonian civilization than we have ever seen. The first structure discovered was an altar of sun dried bricks, 4 m. by 2·46. The upper course had a rim of bitumen, and upon the altar was a large deposit of white ashes. Round the altar was a low wall marking the sacred inclosure. Outside of this inclosure were found two immense vases of terra cotta. These great specimens of early pottery were each 63·5 cm. high and decorated with rope pattern. We have here in this simple, sacred precinct the germ from which sprang the great temples of Chaldea—the altar, with its temenos, entered only by the priest, and the two great vases for purification, replaced in after times by the greater and lesser absu, placed before the temples. A somewhat similar construction was discovered at Sippara, but its archæological value was not recognized. Southeast of the altar was found a remarkable structure, a brick platform, 7 m. square and 3·28 m. high, built of fine unbaked bricks. Round the base of this Mr. Haynes found a quantity of water vents, which indicated a connection with some receptacle below, and on sinking beneath this solid mass he found a drain passing underneath the platform, in the roof of which was the earliest known keystone arch. It is 71 cm. high and has a span 51 cm. The bricks are well baked and joined with stiff clay as mortar. Thus the priority of Chaldea in the use of the keystone arch is clearly established.

This structure was over 7 m. below the pavement of Ur-Gur and 4·57 below that of Naram-Sin, and, since there were no massive ziggurats or great temples to crumble into ruin, it must have taken many centuries to build up so great a mass of débris, and an estimate of from 1,500 to 2,000 years before the time of Sargon does not seem too high.

Over 26,000 tablets as well as numerous inscribed fragments of vases and stelæ have been recovered from this site. It is therefore clear we have no lack of material. Under a pavement of Ur-Ninip, a king of the dynasty of Ur-Gur, were found some hundreds of broken vases and other objects that had been votive offerings to the shrines of Mullil from the earliest times. Among these were some of the most archaic type, and Professor Hilprecht, almost at the loss of his eyesight, has constructed a complete text of 132 lines written in a most archaic character. These records relate to a series of primitive wars and form certainly, whatever their age may be, the oldest historical records known. The earliest of these is the inscription of "Eshagsagana," styled "lord of Kengi," that is, Lower Babylonia, in whose time the chief enemy of Babylonia was the city of Kish, the modern El Hymer, whose priest ruler had entered into alliance with some fierce tribes called "the hosts of the Land of the Bow." The first inscription describes how the Babylonians "conquered the king of Kish and his ally," and spoiled his city. The next inscription is one of the king of "hordes of the bow" who had had his revenge and conquered Babylonia. The conqueror describes his empire as extending from the Lower Sea of the Tigris and Euphrates to the Upper Sea (Mediterranean), and as being granted dominion over all lands from the rising to the setting of the sun, whom he has caused to dwell in peace.

Who were the "hordes of the land of the bow"? Professor Hilprecht has put forward a theory that they are to be identified with the Semitic tribes of North Mesopotamia, and that the "City of the Bow" was Harran. It is rather (our correspondent says) to the plains of Central Mesopotamia and the lowlands between the Tigris and the Kurdish mountains that we must look for the home of these nomadic warriors.

This exploration reflects much credit on its organizers and, above all, on Mr. Haynes. For thirty-two months he lived alone among the wildest Arab tribes in Mesopotamia, in an atmosphere of fever varied with cholera. One determined attempt was made upon his life; yet amid all these surroundings he lived and did the work of three men. He is entitled to a place in the front rank of explorers along with those who have restored to us the first chapters of the world's history.

DRIVING OSTRICHES.

POTCHEFSTROOM, or Mooi River Dorp, was the second seat of government of the Transvaal, the first having been Origstadt, which, being in the low bush country, was first decimated by fever and then deserted; from Potchefstroom the seat of government was removed to Pretoria. It was an out-of-the-way place, and was seldom visited by English, except by hunters and traders on their way to the Zambesi, Lake Ngami and the Matabele and Bamanwato countries, and in the colonies it was very rare to come across any one who had been there. On our way back we purchased at a farm four young ostriches, a few months old, and not quite half grown. We had considerable difficulty in getting them off the farm. A little further we bought three more, a little older and three parts grown, and these gave us proper work to get them away. For a whole day we were chasing them all over the country on foot, for we had brought no horses, not anticipating this kind of work; but they always returned to the house, and toward evening we gave it up. In the morning at daybreak we spanned or hobbled them with silk handkerchiefs, and in this way managed to get them six or seven miles from the farm.

The next day we removed the handkerchiefs, as they were injuring the birds' legs, and for a little while they went along quietly, until they sighted a troop of wildebeestes, when they stretched out their necks and were off at their best pace to join them. We then each seized one of the two wagon whips we had and started after them. If the birds had been real wild ones and full grown we might as well have

started after an express train, for I never sat the horse that could run down a full grown ostrich in a fair course; but they were only three parts grown, and had been domesticated on a farm since they came out of the egg, and they were really more indulging in gambols than making a serious attempt to join the wildebeestes. Consequently, we succeeded in driving them back, but the performance was repeated fifty times during the day, and we had not a moment's rest the whole day. It was quite dark when we at length arrived at the river, and but for the assistance of the rest, who came to our aid, we should never have got them through. At camp we threw ourselves exhausted on the ground, and both declared that it was by far the hardest day's work we had ever done in our lives. The distance we had run after those wretched birds was certainly over fifty miles, and for the greater part of the distance we were cracking heavy wagon whips as well.

These ostriches were afterward a source of endless trouble to us. They grew rapidly, and developed great kicking powers, until they became sometimes positively dangerous, the dogs and the Kafirs coming in for most of their attentions. Their appetite was insatiable; we used to make large quantities of biltong, or sun-dried meat, and there were usually dozens of strips of it hanging on rheims slung from wagon to wagon, and these were always objects of attention on the part of the ostriches. It was most amusing to see one trying to swallow a strip a yard long and two inches thick, just as a chicken struggles with a worm that is a little too big for it. Once we had to drag a huge strip out of one of the birds' throats to save it from choking. But it was the culinary department that interested them most. They would always attack the Kafirs bringing the viands from the "kitchen" to the tent, and sometimes were so pertinacious that the boy would get frightened and throw the dish away and bolt, and we would lose the best part of our dinner. They would even come into the tent and snatch things off the table, and we would take it out of them by smothering a dainty morsel with salt and cayenne pepper; but after a while they seemed to flourish on it. One day, however, we got the laugh on our side. Dinner was preparing, and one of the birds was investigating the pots round the fire; a great pot of huge potatoes took his fancy, and he incontinently seized and swallowed a red hot tuber as big as a large pomegranate. He danced, he jumped, he kicked, he twisted his neck about almost into knots, he flopped his wings and waggled his tail, he ran amuck, knocking things down and banging himself up against the wagons and stone walls, and at last tore away into the veld at twenty miles an hour, until he was out of sight, and did not appear again for a couple of hours.

Every morning, soon after sunrise, these birds would indulge in a dance. They would rush away into the veld for about a mile, and then suddenly stop and commence waltzing round and round in the most ridiculous fashion, often till they dropped. I never could understand the meaning of this performance; it might be mere gamboling, but if so it must be nearly the only case of young birds playing, as so many young animals do. Their keen sense of sight has often been noticed, but it is not generally known that their sense of hearing is quite as acute, and if they were feeding two or three miles away, a few mealies (maize) rattled in a tin pannikin would suffice to bring them back.—South Africa.

THE INTELLIGENCE OF ANTS.

To the Editor of the SCIENTIFIC AMERICAN:

I have often thought that some of the conclusions advanced by Sir John Lubbock in his great work, "Ants, Bees, and Wasps," were, to a certain extent, erroneous. Furthermore, I believe that these faulty deductions on the part of this observer were the result of the unnaturalness and the artificiality of his experiments.

In almost every experiment conducted by Sir John, and detailed in the book referred to above, the ants used were placed amid artificial and specially prepared apparatus; hence, amid new surroundings with which they were utterly unfamiliar.

When we take into consideration the fact that, to an ant, in all probability, every stalk of grass is a forest tree, every bowlder a high and lofty mountain, and every minute crack or crevice in the ground a crevasse or abyss of appalling depth, we will readily comprehend the fact that, when they are transported any distance from the nest and placed among unfamiliar scenes, they must necessarily be handicapped by a perfectly natural bewilderment. Man himself, with all of his vaunted intelligence, would find himself at a loss under like conditions. When studying the psychology of the lower animals, they should be observed, I take it, among natural conditions; experimentation should be as inartificial as possible.

Ants soon arrive at a thorough knowledge of the country surrounding their nests; they very soon become familiar with the "lay of the land" over which they range. Hence, in the following experiments and observations, I have observed the ant at home; I have not placed an additional and unfair burden upon her intelligence by transporting her to a foreign country amid unknown scenes. Furthermore, I have not taxed her ratiocinative powers beyond their physio-psychological limits, as was done in more than one of Lubbock's experiments.

In front of my house there is a paved walk ten feet broad and three hundred feet long. Beneath the bricks of this pavement are the homes of several species of ants. These ants were the subjects of my experimentations, and this pavement was the place where the experiments were made.

In summing up his observations on the extent to which vision aids ants in finding their way, Lubbock says that ants, at least the species (Lasius niger) experimented with by him, guide themselves but little, if at all, by sight. I am convinced that this is an error; an error engendered, first, by the unnecessary artificiality of his experiments; second, by his ignoring the limit of the range of vision in L. niger.

Two larvæ or grubs of L. niger were placed on a nickel five cent piece some ten inches from the nest and a marked ant put to them. She examined them carefully, then, picking up one, she carried it to the nest. While she was absent, I placed another grub on the coin. She soon returned and again carried a larvæ into the nest. While she was absent on her second trip, I moved the coin and larvæ some eight inches to the right. When she returned, she passed over the original spot, then circled about as though looking for the desired object; finally, after several minutes' search, she entered the nest without having found the coin.

I performed this experiment repeatedly, gradually lessening the distance between the two points until I arrived at the distance of 1 in. between the spot made familiar to the ants by repeated visits and the point to which the larvæ were removed while the ants were absent. The ants seemed to be able to see the coin and larvæ at this distance, for they went to them at once, as soon as they discovered that they were not at the accustomed place.

This experiment was repeated time and again, always with a like result. At any distance over 1 in., however, the ants appeared nonplussed, and immediately began to hunt here and there for the coin and grubs. I believe that I do not claim too much when I assert that the ants were able to recognize these objects, at least at the distance of an inch. Moreover, I had reason to believe that their range of vision extended even farther, for on several occasions I had seen them turn and flee when they had unwittingly strayed within two or three inches of a "devil's race horse" (Phasmomantis carolina). I therefore tested their vision for greater distances in the following experiments:

I put several larvæ on a pillar 4 in. high and 2 in. thick. This I placed some distance from the nest, and, after I had accustomed a marked ant to the road between the pillar and the nest, I moved the former and stationed it some 10 in. away. The ants were unable to see it at this distance, but when the interval had been reduced to 2½ in., they found the pillar without difficulty. Experiments with larger objects, at greater distances, amounted to nil. Hence, I think that the extreme range of vision in L. niger approximates 3 in.

In order to determine whether or not smell was absolutely necessary in finding their way, I proceeded as follows:

Between the pillar and the nest (and thereby bridging one of the sulci between the bricks) I placed a piece of writing paper, 2 in. long and 1 in. broad; this bridge was directly in the ant's established pathway. When the ant arrived at the paper, she stopped, then turned and retraced her path several inches toward the nest; she again turned, walked across the paper and made her way to the pillar. When she first arrived at the paper, she evidently recognized the fact that here was something new and unknown in her path; bewildered for the moment, she turned and went back; finally, however, her sense of direction triumphed—she knew that the pillar was in a certain direction and that that direction was beyond the paper, so she traversed the bridge and went on her way to the pillar. It is hardly possible, nay, I believe that it is impossible, that she smelled out her route through the paper; indeed, I noticed that she followed the edge of the paper at least a half inch away from her old route.

Lubbock made an ant pass between several wooden blocks on her way to and from some food; he then changed the direction of the blocks until the space between them was tangential to the old route. Yet the ant invariably followed her accustomed path without noticing the blocks. He gives this as evidence substantiating his claim that ants are not guided by sight. I do not think that this is a fair conclusion. Suppose a man follows the footprints of another man through a lane which has a fence on each side; suppose these fences are changed during the night so that they will run tangential to their old site; must the man traverse the space between the fences if he desires to again follow the footprints?

I believe that the microscopic eyesight of the ant seizes on objects immediately at her feet—objects so infinitesimally minute that we have no cognizance of them at all. I believe that it is by such landmarks that she marks out and recognizes her route to and from any point. Of course, that most wonderful sense, the sense of direction (which all animals, save man, possess in some degree), has a great deal to do with the guidance of ants, but not all, by any manner of means. Even blind ants follow corridors, passageways and tunnels, hence it would seem that touch, and not smell, was the guiding sense, at least in blind species.

Again, in order to further investigate this question, I made a company of ants pass over a paper bridge on their way to a pile of bread crumbs. After the route had been well established and the ants had been passing to and fro over the paper for some time, I removed the bridge and placed it across another line of march which had been established by another company of ants which was busily engaged in carrying some larvæ into the nest. The paper bridge was placed athwart the line of the larvæ carriers, yet these latter did not appear to notice the trail of their companions on the paper, but crossed it at a right angle and passed on to the larvæ or to the nest.

Lubbock's experiments are always exceedingly elaborate, and it is this very quality of elaborateness which, in my opinion, very frequently militates against a correct result. He is rather disposed to question the often repeated and well authenticated statement that ants disinter comrades which have been accidentally buried, simply because, in his highly artificial experiments, they failed so to do.

Probably, if he had dispensed with his intricate and elaborate apparatus, consisting of "a vessel containing honey, which vessel rested in another containing water; a shallow box containing powdered earth; a paper bridge, etc.," and had experimented, naturally and inartificially, with ants which were at home and amid well known and familiar surroundings, his results would have been different. Moreover, in his experiments, he expected the ants to solve problems which man, with all of his intelligence, would find absolutely and entirely beyond his powers.

He accustomed some ants to cross a box of powdered earth on their way to a vessel of honey; after they had learned the route, he buried several of them in the powdered earth. "At 7 A. M., the next morning, the honey was all gone, two or three were wandering about, but no notice had been taken of the prisoners, whom he then let out."

Suppose a company of desperadoes seized a man and buried him in the middle of the public highway; suppose, also, that no one saw this burial save those who committed the outrage, that it was utterly unknown; is it at all probable that passersby on that highway would discover that a man was buried in the road? And yet, Sir John expected his ants to solve just such a problem!

That ants, on occasions, do disinter buried comrades cannot be questioned. Whether or not they are influenced by affection and pity to render aid to their hapless kindred, I know not; yet the fact remains that they do.

Seating myself beside a nest of Lasius flavus, I noticed that numerous small workers were bringing up the earth and depositing it in a circle about the entrance. Several large workers were walking about, seemingly directing the small workers where to lay down their loads. Seizing my opportunity, I suddenly buried three small workers beneath a pinch of sand. The large workers immediately hurried into the nest, from which, in a few seconds' time, there issued a crowd of small workers which at once began to remove the sand. In a very few moments the buried ants were disinterred, and were then carefully cleaned by the tongues of their rescuers!

In this experiment I endeavored to imitate a natural phenomenon. I produced a catastrophe, which, doubtless, frequently occurs to ants in a state of nature. A sudden and violent gust of wind or the busy feet of some industrious fowl have, unquestionably, often brought about just such miniature avalanches of sand.

Again, I glued an ant by one leg to a brick with some quick-drying cement. The struggling creature was soon discovered by some of her sisters, which at once began to free her by eating the glue about her feet. They quickly set her at liberty, but did not abandon her until they had thoroughly cleansed her. Thinking that, probably, they were influenced by a personal motive, i. e., that they ate the glue because they liked it, I mixed some quinine with it and then fastened another ant to the brick. She was soon surrounded by several comrades. I saw them bite the glue and then step aside and endeavor to rid their lips and tongues of the objectionably tasting substance. They returned, however, to their task, nor did they cease until they had freed the prisoner and had thoroughly purified her.

This seemed like true, disinterested pity and affection, especially since some of the ants were made sick by the quinine. I am fully aware of the fact that many observers have attributed a certain degree of emotional æstheticism to ants; yet it would be exceedingly difficult to prove that any element of æstheticism enters into the pity, sympathy or affection that these creatures may entertain for one another. Their interests are so entirely communal that individualism (the communal mother and, sometimes, the communal father being excepted) is entirely unknown; hence, any interest evinced by an ant toward another ant must be, necessarily and fundamentally, selfish in its nature. Incidentally it is for the good of the individual, but primarily and principally it is for the good of the colony, inasmuch as each individual is a fraction of the integer, which would be, to a certain extent, marred by the loss of a single ant!

That ants do evince a material interest in one another cannot be disputed; and such is their status in the economy of nature, that it is well for them, perhaps, that this interest is material instead of æsthetic.

On one occasion I disabled a rufous ant by amputating two of her legs. I then placed her near the entrance to her nest. An ant came out and, after examining her critically, took her up and carried her into the nest. Lubbock gives an instance of ants nursing and caring for a sick comrade. McCook, Forel, Huber, Belt, Bates, and many other observers also give instances of ants caring for and assisting wounded or sick comrades; therefore, I think that we may accept it as a fact. Yet Lubbock seems to infer from his bottle experiment that ants do not assist one another when in difficulty. He put some ants in a bottle, over the mouth of which he tied a piece of thin muslin. These imprisoned ants were visited by their friends, yet no effort was made to liberate them.

If a glass wall reached from the equator to the zenith and encircled the entire earth, thus separating the inhabitants of the world, the people on the north side of the wall, I take it, would consider themselves just as free as those who dwelt on the south side of it. The ants, in Lubbock's experiment, reasoned pretty much in the same way. The ants in the bottle did not know that they were imprisoned, nor were the ants on the outside any wiser. The experimenter ignored the physio-psychical limitations of the animals under observation. If, in his experiment, he had made the ants cognizant of the fact that their friends were imprisoned, they would have endeavored to free them; of this I have not the slightest doubt.

The tender and watchful care that is bestowed on the young ants by their foster mothers is exceedingly striking. In fact, were it not for these watchful guardians, the young imagoes would die in infancy, for the young ants cannot emerge from their cocoons unaided; they will die as pseudo-crysalides unless the old ants assist them to come out.

The education of the young takes place in the darkness of the nest, and they are put to work early in life. In point of fact, I have seen the young of rufous ants, only six hours old, busily engaged in caring for pupæ which were about to emerge from their cocoons.

It was my fortunate privilege very recently (May 22) to witness a sight not vouchsafed to many observers. In fact, I can find nowhere recorded a like instance. So it probably stands unique in the history of ants. I was observing a colony of yellow ants (L. flavus) when a dozen or two large-headed individuals came out of the nest and carefully quartered the ground to and fro in its vicinity. They seemed to be a scouting party sent out for the purpose of seeing if there were any enemies in the neighborhood. After they had examined the ground for several feet on all sides of the nest, they came back and stationed themselves about the entrance. In a few moments a large number of young ants came out accompanied by a number of ordinary workers. The large-headed ants formed a circle about the entrance of the nest and kept the young ones from straying away. These latter, apparently, were out for exercise or play, for they raced about, wrestled with one another, and indulged in mimic battles. The

workers walked about among them for all the world like monitors or ushers in charge of a company of school boys. This strange scene lasted for fully two hours; the young ants then gradually went into the nest, followed by the workers; finally the large-headed individuals disappeared and this astounding show came to an end. I called my gardener to witness this unique performance, but I must confess that he disappointed me by saying that he saw "nothing at all wonderful in the affair."

Several observers have stated that they have seen ants at play, but none of them have recorded the fact that they have ever seen young ants engaged in any such performance as I witnessed.

JAMES WEIR, JR., M.D.

ANIMAL COLONIES AND THE FORMATION OF ORGANISMS.

LAMARCK was the first to assert that, although the origin of life still remains mysterious, scientists should not consider the mystery as impenetrable. Life must have appeared upon the earth under the action of forces that are still acting, but that we do not know how to combine, and the illustrious naturalist endeavored, as far as it was possible in his time, to ascertain how the miracle of such appearance had been performed. Supposing this problem (which we ourselves will doubtless have to relegate to the scientists of the next century) to be solved, and recognizing the fact that there are simple and complicated animals, he was naturally led to ask if the latter did result from an improvement of the former. It seems to him that the organism of living beings must have varied by very reason of the variety of the terrestrial world. Two similar animals, placed in different conditions, must, according to him, have experienced different needs, and, in order to satisfy these, must have used their organs differently. The same organs, left in repose by one and put in activity by the other, must have become atrophied in the first and become developed in the second. At the end of a certain length of time, these animals, primitively alike, must therefore have become different. The variations thus acquired by exercise or disease of the organs must have been transmitted by heredity. Hence the diversity of living forms.

Unfortunately, although Lamarck succeeded in plausibly explaining the modifications of organs that already exist, their adaptation to different uses, or even their disappearance in consequence of their inertia, he was able, as regards the appearance of new organs, to make suppositions only that were so hazardous that they caused his powerful conception to be momentarily forgotten.

Lamarck's theory, being based upon the existence of a sensation, that of need, which in turn brought in the intervention of a faculty essentially animal, that of will, was, moreover, inapplicable to plants. Although it permitted of understanding in a certain measure that the animal organism had been the subject of gradual and continuous modifications, it took no account of one indisputable fact common to the two kingdoms—the existence of species, that is to say, of forms which, even when they are allied, as the dog, wolf and fox, the rabbit and the hare, or our little singing birds, can live side by side without intermixing and without any transition ever being found between them.

It is just this aspect of the question that Darwin examines. Leaving aside the question of the origin of living forms, taking them at any degree of complication whatever, and even abstaining from trying to ascertain under what influences such forms become modified, Darwin borrows his starting point from Lamarck—the heredity of characters acquired during life in any manner whatever. He then shows how, the hereditary variations having been once acquired, the multiplication of similar but not identical living beings in the same region involves a struggle for existence, in consequence of which those beings alone that possess the most advantageous characters under given conditions succeed in living for a long time and in reproducing themselves. Such survival of the fittest has for counterpart the disappearance of the less favored. So the advantageous variations exalt themselves from generation to generation. Every useful variation is soon carried to its maximum of intensity in some individuals, and the latter hence cause the disappearance of all those that come in late behind them. The chain of variation that connected the individuals existing at their starting point is thus broken, and a new species, entirely isolated in appearance, has been created. What Darwin has endeavored thus to explain is therefore indeed, as the title of his book shows, the Origin of the Species. What Lamarck proposed was an entirely different problem, that of the origin of variations in animal forms. The solutions that the two proposed leave out a third problem, that of the formation of organisms and of the causes that have led to their gradual complication.

I have endeavored to broach this third problem in a book that I have published under the title of "The Animal Colonies and the Formation of Organisms." The conditions under which it is proposed are now very plain. All the micrographic studies to which innumerable naturalists have been devoting themselves for more than sixty years past, and that have now attained the utmost precision, lead to the formulation of the following proposition: All living beings easily visible to the naked eye are formed through the agglomeration, in quantities that are often innumerable, of microscopic elements of quite complex but constant structure, differing from each other only in secondary details of form, and which are named indifferently "anatomical elements" or "plastids."

On the contrary, the majority of the microscopic living beings are formed of a single plastid capable of multiplying itself by division, and the plastids that emanate one from another in this way rapidly cease to exhibit any tie between them. These beings formed from a single plastid (Fig. 1) constitute a large group in the animal kingdom, that of the Protozoa, of which the infusoria are the best known representatives. In the vegetable kingdom they are the simplest of the fungi and algæ. The microbes and bacteria are examples of the latter that have now become familiar.

On another hand, however varied be the phenomena of multiplication in the organisms formed by an association of plastids, in the vegetable as well as in the animal kingdom, the pluricellular organisms always have for a starting point a single plastid, the egg, and the innumerable plastids that concur in the formation of the body of a high organism are all, without exception, derived from the repeated divisions of this primitive plastid.

Since in the present world every individual begins by being reduced to a single plastid, and since there still exist in our day a large number of beings that remain reduced to such state, it is natural to conclude that the first living beings were all unicellular, and that, consequently, the original ancestors of animals entered into the great category of Protozoa. This conclusion will assume considerable force if there still exist series that rise without too abrupt starts from the Protozoa to the most complex forms of the animal kingdom. Further along the question will be proposed whether such forms have been created all at once or

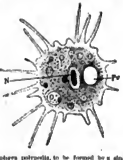


FIG. 1.—Dactylosphæra polypodia, to be formed by a single plastid, the substance of which is drawn out in threads temporarily. (Highly magnified.) N, nucleus that presides in the nutrition of the plastid; Pv, vesicle that expels waste material of nutrition.

whether they have been produced by successive stages, and whether it is not possible to recognize in the realization of such stages the constant exercise of some faculty common to living beings. Such faculty once known, the proximate cause of the complication of organisms would be by that very fact determined, and we should have to endeavor to ascend from this cause to others that are more profound.

Now, an attentive study of the animal kingdom shows that all the pluricellular organisms that compose it allow themselves to be easily grouped in five series:

1. SPONGES (Calcareous sponges and Siliceo-corneous sponges).

2. POLYPS (Hydromedusæ, Siphonophoræ, Acalephæ, Ctenophoræ, Coralliaria).

3. ECHINODERMS (Cystoids, Blastoids, Asteroids, Ophiuroids, Echinoids, Holothuroids, Crinoids).

4. CHITINOPHORÆ (Arthropods: Onychophoræ, Merostomæ, Arachnida, Pycnogonidæ, Crustacea, Myriapods, Insects; Nemathelminthes: Echinoderidæ, Acanthocephala, Gordiacidæ, Desmoscolecidæ, Nematoids).

5. NEPHRIDIÆ (Lophostomæ: Rotifers, Bryozoans, Brachiopods; Worms, Mollusks, Tunicates, Vertebrates).

In each of these series the organisms may be arranged according to an order of increasing complication, from a simple form in which we observe no other repetition of parts than that of the plastids (which, moreover, are apt to group themselves into dissimilar organs) up to diversely complicated forms whose body divides in most cases into parts that are more or less similar, and in which all the organs are repeated. Each of the parts into which the complex forms are decomposed has, moreover, exactly the same structure as the form with which the series begins. It is, therefore, possible to connect all the organic forms comprised in a same series of the animal kingdom by a simple law: The complex forms of a given organic series of the animal kingdom are only an aggregate of parts identical with the simplest form of such series. It is to aggregates of this kind that naturalists have given the name of colonies.

In the presence of this general proposition, we may give a name to the initial form of each series, and we shall call it a merid. We shall designate the complex forms as zooids. A zooid will, therefore, be a sum of merids, just as a merid is a sum of plastids.

In the most complex organisms, the body is not solely divided into merids. We quite often distinguish therein groups of merids that assume a more or less marked individuality and may even separate from the zooid in order to lead an independent existence. Each of these groups must be considered as a zooid. The entire organism is, therefore, either a sum of merids and zooids or a sum of zooids, that is to say, something more complex than a zooid. The organisms thus constituted we shall call demes. A simple law still further connects the zooids and demes in the same series: In each series of the animal kingdom the lowest forms are merids. Afterward come the forms constituted by the repetition of merids all alike, and which are, consequently, zooids. Finally come the forms constituted by a sum of zooids that are in general different from each other, and that, consequently, have the signification of demes.

Thus, the plastids do not seem destined to constitute an organism all at once. Just as men do not form, all at once, great nations that are centralized to such a point as to be but a single body of which all the parts are harmoniously founded, just so the plastids unite feebly in the first place (Fig. 2), and then become aggregated into merids, which afterward become aggregated into zooids, that in turn form demes. Just as the ties that connect the tribes of the same people, and the cities and provinces of the same nation, are in the first place quite lax, but become closer in measure as the relations become easier and the common interests become more numerous, just so the merids and the zooids, which might at first easily separate from each other in order to lead an independent existence, become more and more thoroughly independent and finally become no longer separable.

The instrument of such solidarization is the same in both cases. In human societies, progress is due to the variety of aptitudes combined with individual initiative. Every happy initiative assures advantages to those who have taken it, and of these they have doubtless the exclusive benefit for a certain length of time; but their prosperity soon becomes an advantage to the family and to the people of which they form part. Such initiatives are exercised in different directions, by very reason of the variety of the faculties of the individuals. It soon results that each assumes a role that is adapted to him in the society of which he forms part, and such division of roles between the initiators is what is called a "division of labor." As the labor of each is profitable to all, and as each one works according to his aptitudes, if a sufficient initiative is left to him, and consequently works better than if a task for which he is not fitted is imposed upon him, and as every laborer does so much the more perfect work in proportion as he devotes himself thereto more exclusively, the division of labor leads to the consequence that a relatively limited number of individuals have in charge the production of the objects that are indispensable to all. From this moment, all the producers become reciprocally necessary, and a close interdependence is established between them. They become thereafter inseparable from one another, and the society to which they belong acquires by that fact all the characters of an individuality of a high order. The role that each individual played voluntarily becomes a social function.

The function, moreover, impresses upon those who exclusively exercise it special external characters that permit of the recognition, with some precision (by a practiced eye, at least), of the soldier, the priest, the magistrate, and the laborer, and, among the laborers, the corps of trades often have a certain manner which, even in the absence of any special costume, clearly betrays them. The division of labor, while inducing solidarity, therefore induces a sort of polymorphism of the individuals. The individuals who perform the same function, or similar functions, whence they derive their origin, necessarily have interests in common. Peculiar ties are established between them and through their union they form corporations or syndicates that also possess a certain individuality, but a subordinate one, since it represents simply a function that would no longer have a reason to exist if the social body disappeared.

The unity of the social body, its solidarity, is, moreover, reinforced by the advent of real ties that put all its parts in intellectual communication, as do correspondence, newspapers and books. The organs of these material ties, by the very fact that they are designed to establish relations between all the parts of the social organism, are essentially, at the bottom, undivided properties, so that they may be momentarily exploited by private individuals. It is clear that the degree of improvement and development of undivided properties measures the degree of solidarity of the social body to which they belong.

All these things are evident, even from a superficial study of human societies. So, some physiologists, struck by the resemblances to animal organisms that such societies exhibit, have endeavored to deduce laws of political economy, those of the progress of organization, while politicians or philosophers, reversing the problem, have sought for comparisons suitable to sustain their conceptions in the history of the progress of animal organization. The problem thus reversed is evidently alone proposed in a scientific manner. It is rightly that Messrs. Espinas, Izoulet and Worms see in our human societies the last actual term of an evolution that has gone on through the entire animal kingdom. Hence an exact knowledge of the conditions and laws of this evolution assumes a philosophic importance of the first order, since such conditions and such laws, well understood, determine the place of man in nature and teach him his rights and his duties, not only with respect to his similars, but also with respect to all that surrounds him, living beings or inanimate objects. They are the sole bases upon which, in a society that asserts itself eminently laical, can be built a general

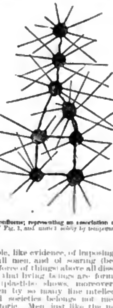


FIG. 2.—Monobia confluens; representing an association of plastids analogous to that of Fig. 1, and united solely by temporary prolongations of their bodies.

morality capable, like evidence, of imposing itself upon the minds of all men, and of soaring (because it results from the force of things) above all dissensions.

The sole fact that living beings are formed of individual units (plastids) shows, moreover, that the parallelism seen by so many fine intellects between organisms and societies belongs not merely to the domain of rhetoric. Men, just like the most humble plastids, are subjected to the triple necessity of feeding themselves, of assuring their individual security and of multiplying. The societies of the one, like those of the other, have no other object than that of being able to provide for this triple necessity by the most appropriate means. From the identity of object result resemblances that are so much the less debatable in proportion as the means employed to this effect are governed by the same conditions in general that form

what we call life. It is therefore useful, by taking a well defined example, to state with precision the successive stages of the organic complication in a determinate series, and we shall select that of the polyps as presenting the clearest phenomena.

Here the initial merid, which it is easy for everyone to observe, and which has been rendered celebrated by Trembley's experiments, is the fresh water hydra. This animal is a sort of cornet fixed by its closed extremity to walls formed of two superposed layers of plastids and with an aperture surrounded by hollow flexible prolongations called tentacles. The best fed hydra does not exceed a centimeter in length. As soon as it has reached this size it, instead of continuing to grow, produces a protuberance at some point or other of its body. This protuberance, which, as in plants, is called a bud, soon becomes a hydra similar to the first. The young hydra detaches itself before long and begins to lead an independent life. This phenomenon occurs during the entire summer; but in the autumn the animal produces eggs, which in the spring give birth to a new hydra.

The hydra, therefore, lives in the state of a merid. However, when abundantly fed and kept at a proper temperature, the hydras that have budded one upon another separate but tardily. Trembley has thus been able to obtain small trees formed of twenty superposed hydras whose digestive cavities all communicated. These hydras, which are apt to separate at the least accident, when they remain united under favorable conditions, constitute but one and the same organism; that is, a zooid. In fact, the majority of the animals allied to the hydras remain in this zooid state permanently (Fig. 3). All the individuals generated

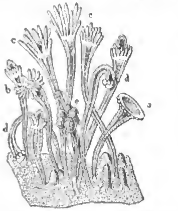


FIG. 3.—Hydractinia echinata. Fragment of a hydrozooid magnified about fifteen times: a, b, c, nutritive merids diversely expanded; d, d, tactile merids; c, reproductive merids.

one upon another constitute arborescent zooids, whose form is often definite. To obtain such a result, it suffices that the hydras shall produce a sheath which extends over the buds when they are formed and protects them against accidents and consequently favors the union of all the individuals. The organisms thus formed may be called hydrozooids, and the merids that constitute them may be styled hydromerids.

Since, in a hydrozooid, the digestive cavities of all the hydromerids communicate with each other, it may happen that a portion of the merids suffices for capturing and elaborating the quantity of food necessary for all. The others will therefore be able to do without a mouth. Their non stimulated digestive faculties will become enfeebled, while their faculties of motion or sensitiveness will become exalted and their form be consequently modified. In fact, in a very large number of hydrozooids (Fig. 3) we distinguish, by their form and very different functions, nutritive merids, prehensile merids, tactile merids, defensive merids, fixing merids, reproductive merids, etc. Social life here, as in human societies, has led to a division of physiological labor, polymorphism and solidarity, since our dissimilar merids can no longer separate from each other without exposing themselves to the danger of dying.

As a general thing, a certain number of merids become modified around reproductive ones in order to form a protecting apparatus for them. One of the most remarkable cases, by reason of its frequency and its consequences, is that in which four prehensile merids form a verticil beneath a reproductive merid, which is provided with a mouth, but the tentacles of which are often abortive. When such prehensile merids are agitated in water by reason of the resistance of the liquid, they draw to themselves simultaneously the region of the internode upon which they are

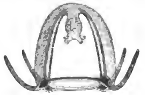


FIG. 4.—Reproductive hydromerid or medusa of Podocoryne carnea, free and completely developed.

fixed and expand it into a bell that hangs down around the reproductive merid. Naturally, this bell carries by its free edge the four prehensile merids. It is contractile, and every time that it closes it drives the amassed water into its concavity. The expulsion of this water brings about a movement of recoil of the bottom of the bell, the peduncle of which, pulled by these abrupt motions, finally breaks. The bouquet of five hydromerids thus set at liberty possesses all that is requisite to allow it to live in an independent manner—a mouth, a stomach, a locomotive apparatus, merids serving as organs of prehension, and reproductive organs even. This bouquet thereafter becomes an autonomous organism. It is what is called a medusa (Fig. 4). A medusa is a hydrozooid. Every association of hydromerids upon which one of these forms, comprising, therefore, merids and zooids, will, in a general

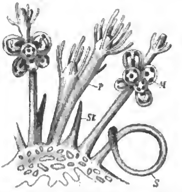


FIG. 5.—Fragment of a hydrodeme of Podocoryne carnea, formed of nutritive hydromerids, P, tactile hydromerids, S, defensive hydromerids, St, and reproductive hydrozooids, or medusæ, M. (Magnified about fifteen times.)

manner, be a deme, and in the species, a hydrodeme (Fig. 5).

Some singular hydrodemes, instead of fixing themselves to the ground, as usually happens, attach themselves to a bubble of air and then constitute floating hydrodemes. In such hydrodemes, a certain number of medusæ cease to serve for reproduction and operate as locomotive organs, which work in concert to assure the displacement of the hydrodeme. The hydrodemes thus formed exhibit, with a definite shape for each species, a very great variety of structure. They constitute an entire class of hydro-medusæ, that of the Siphonophoræ (Fig. 6).

The hydromerids exhibit still another mode of grouping, which ends in the formation of a radiating organism called corallizooid, the type of which is the sea anemone (Fig. 7). These corallizooids are ordinarily grouped into coralliodemes, and constitute a class of polyps also, that of the Coralliens.

FIG. 6.—Siphonophora or floating hydrodeme. (Capalia [illegible].) Pn, float containing a bubble of air; S, locomotive medusæ; P, nutritive merids; D, protective merids; Sk, prehensile merids.

The medusa is the reproductive form of the primitive hydrodemes. It grows upon the hydrozooid like a flower upon a plant. It happens in an entire series of polyps that the hydrozooid assumes less and less importance. The egg appears to hasten toward the production of the medusa, which it ends by directly forming. This haste of the egg toward the formation of a complicated organism, and which is observed, too, in the Siphonophoræ, is a phenomenon found in the entire animal kingdom. It is the phenomenon of embryonic acceleration or tachygenesis. Its importance is such that comparative embryogeny is, at the bottom, only a study of its laws. The medusæ of direct development form the class of Acalephs, whence appears to be derived that of the Ctenophoræ.

The ties that connect the organisms of the series of polyps therefore appear here of extreme simplicity. The limitation of the size of the merids, the germination or budding, the association of the merids due to budding of one upon another, their differentiation, the division of labor among them, and the solidarization of certain merids announce the advent of the merids

FIG. 7.—Sagartia nivea. A corallizooid formed by hydromerids arranged in radii.

and consequently the transformation of the hydrozooid into a hydrodeme, the solidarization of all the parts of the hydrodeme announces the formation of the Siphonophoræ; and finally, embryonic acceleration leads step by step to the direct production of a hydrozooid by the egg. Such are the stages traversed. It would be easy to show entirely analogous ones in the series of Sponges or in that of the Echinoderms.

In these three series, the merid, having made its exit from the egg, which for this reason may be called the oomerid, fixes itself. Let us now suppose an oomerid free, as are all those that are notably heavier than water. In this case, it will not be able to raise itself erect and wait with open mouth for food to be brought to it by the surrounding water, and yet the budding will not disappear on that account, but will take place under very peculiar conditions.

Submitted to the necessity of searching for food, such a merid will be led to move in carrying to the front the extremity of the body in which its mouth is situated. Therefore, every bud that appears elsewhere than at the posterior extremity of the body will be applied against the walls of the latter during locomotion and be led to fasten itself thereto. The merid will therefore bud only at this posterior extremity, and the zooid resulting from such budding will necessarily be an organism formed of segments placed end to end—a segmented organism, such as an insect (Fig. 8), an earthworm or a leech. It is for the animals thus formed that Cuvier created the branch of Articulates. But all recent researches have shown that the segmentation of the body is not a character peculiar to Cuvier's articulated animals. We see, in fact, segmentation gradually becoming effaced, under the influence of parasitism, in the arthropods that pass by sparing transitions to the Nematoids, the type of which is the Ascaris lumbricoides, or intestinal worm so often passed by children. Under the same influence of parasitism, segmentation is gradually effaced, too, in the annelid worms, which thus pass to the flat ones.

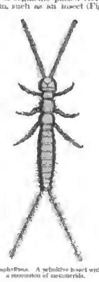


FIG. 8.—Campodea staphylinus. A primitive insect with a body formed of a succession of metamerids.

Despite the apparent unity of their bodies, the mollusks themselves, such as snails and oysters, exhibit in the course of their development very plain traces of segmentation. As for the segmentation of the bodies of the vertebrates, that had already been recognized by Geoffroy Saint Hilaire, merely through a study of the skeleton, the vertebræ and ribs of which are repeated with so much regularity, and it was put out of all manner of doubt by the labors of Balfour, Semper, Sprengel and others upon the structure of the renal apparatus of these animals. So all animals whose body is not ramified by budding, and which get beyond the state of merid, have a segmented body or one derived from animals whose body was segmented. They have been produced by the same mechanism as the ramified animals—by budding, only such budding, instead of being exercised in an irregular manner, as in the fixed merids, has been rendered regular by the exercise of locomotion, the faculty of which has been preserved by the heavy merids.

Embryogeny demonstrates that the merids that are the progenitors of segmented organisms are very likely rotifers (Fig. 9). The lower annelid worms are pro-

duced, in fact, under what is called the "trochosphere form" (Fig. 9), which is represented almost exactly by a rotifer of the Philippines, the Trochosphæra æquatorialis (Fig. 10), and it is also under this form that are produced the majority of the mollusks. So, too, the lower Crustaceans are all produced under what is called the "nauplius form" (Fig. 10), which is also nearly recalled by certain other rotifers—the Pedalions (Fig. 11).

The worms, mollusks and vertebrates probably descended from normal rotifers, and the arthropods and nemathelminthes, according to the recent researches

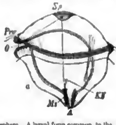


FIG. 9.—Trochosphere. A larval form common to the annelid worms and mollusks. (Highly magnified.) Sp, nervous plate; Prv, band of vibratile cilia used for locomotion; O, mouth; KS, kidneys; Ms, first rudiments of the internal tissues; A, posterior orifice of the digestive tube.

of De Zograf, from rotifers that have become cuirassed with chitine.

Starting from this conception, the entire history of the segmented organisms is of remarkable clearness, and is closely connected with that of the ramified organisms.

Two conditions of existence of the merids, which are themselves connected with the relative weight of such organisms, explain that in the polymerid animals there were two types of structure, and two only, and that one of these closely recalls the type of structure of plants, which, like them, are fixed. The same theory, therefore, embraces the history of the organic complication in the vegetable as well as in the animal kingdom. Such a result, obtained not by a simple effort of the imagination, but by the strictly scientific grouping of indubitable facts, is worthy of our attention, since it gives to the investigation of comparative anatomy and

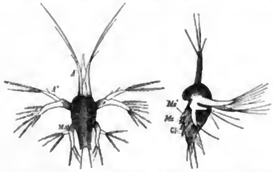


FIG. 10.—Nauplius or larval form common to all the crustacea (back and profile views). A', first pair of organs, which will become the antennules of the adult; A'', second pair of organs, which will become the antennæ; Mdf, third pair of organs, which will change into mandibles; Mx, Mx', Gl, the succeeding limbs.

embryogeny a precise method. It furnishes an explanation of the partial laws previously expressed, shows their raison d'etre, determines reciprocal relations, and, finally, closely connects biology with sociology, which is merely the terminal stadium thereof.

Nevertheless, an endeavor has been made in recent times to give explanations of the segmentation of the body of symmetrical animals that would put it outside

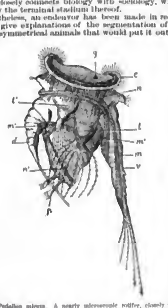


FIG. 11.—Pedalion mirum. A nearly microscopic rotifer, closely resembling a nauplius (side view). g, eyes; c, ciliated ring; m, m', m'', n, n', muscles; dv, odd limbs; t, t', even limbs analogous to those of nauplius; p, tactile organs.

of the general conception that we have just developed. One has wished to see therein the consequence of the undulations of the body of an annelid worm about to swim—undulations that would have broken in a regular manner either the muscular fibers or the genital organs primitively arranged in the interior of the body in two solid columns.

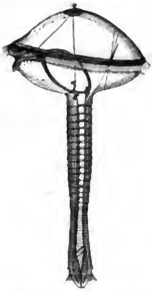


FIG. 12.—Trochosphere of the same species that is shown in Fig. 9, and which has already produced a large portion of the body of an adult annelid worm. The segments are so much the younger and consequently so much the less developed in proportion as the posterior extremity of the body is approached.

An endeavor likewise has been made to explain this remarkable and general division of the body into successive segments by admitting that, in order to increase its digestive power, the intestine has been regularly folded and has subsequently caused the folding of the walls of the body. It has been said, too, that the segmentation is the result of the too great dimensions attained by the organism, which has been obliged to divide into secondary organisms, just as a large country is divided into provinces or departments. It has been connected by some with the formation of the genital segments, which would have primitively detached themselves one after the other, as still do those of the Tænias or tapeworms. In the first hypothesis all the segments

FIG. 13.—An Autolytus that has produced a head toward the middle of its body, and is upon the point of dividing into two.

of the body must have formed simultaneously in the adult animal. On the contrary, they form successively and only in the young, as shown in Fig. 12. The second hypothesis could be applied neither to the arthropods nor to the worms, whose digestive tube remains nearly straight, save in a few very modified forms. Now the segmentation of the vertebrates is manifestly of the same nature as that of the annelid worms, and it is not necessary to invent a particular explanation for it. Before this second hypothesis, moreover, rises the same objection as before the third, to wit, that, according to both, the segmentation must have been specially

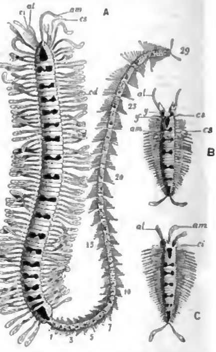


FIG. 14.—A. Myrianis. An annelid worm from which have budded twenty-nine young ones at its posterior extremity. B, Male individual, produced by budding, and that has become free. C. Female individual of the same. am, al, antennæ; ci, cd, cs, tactile cirrhi.

marked in the organisms of larger size, or has especially reached its full effect in the humblest worms, the Syllidians, the Naidians and the Microstomes. As might have been expected in these very simple and very primitive forms, the segments have preserved such an independence that they may be separated from each other by groups, either because there is produced toward the middle of the body a head and a tail that complete two animals designed soon to live each on its own account, as is seen in the Autolytus (Fig. 13), or because the animal, after reaching a certain size, gives rise in buds at the posterior extremity of its body, as do the Myrianes (Fig. 14), to a chain of small ones that detach themselves one by one in commencing with that which is situated the farthest behind. As a general thing, the zooids that detach themselves thus are sexual, while the one from which they isolate themselves is asexual. They are even capable of exhibiting characters quite different from those of their parent. They are, consequently, reproductive zooids comparable to the medusæ, from which they differ especially in the arrangement of the parts, which are verticilliate in the medusæ and placed

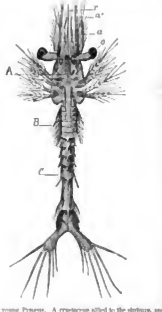


FIG. 15.—Very young Peneus. A crustacean allied to the shrimps, and in which the thoracic region, B, and the abdominal region, C, are in the process of formation back of the head. r, beak; a, a', antennæ; o, eyes.

end to end in the annelid worms. Finally, the fourth hypothesis differs from our general theory only by the very useless introduction of the function of reproduction into the appearance of budding.

The explanation of the metameridation that results from what is calle the theory of animal colonies presents none of these difficulties. Moreover, if it is the

simplest worms that are the most distinctly segmented. If, when the segmentation is merely temporary, it is always in embryos that it shows itself, and if in every series of the animal kingdom it is always the lower forms that are produced in the state of merids, that implies that the metameridiation is the very mechanism of the formation of the body, and not a method of improvement of a body already formed.

A segmented animal is therefore a linear colony of merids, as Durand de Gros perceived as long ago as 1851 and Dugas as long ago as 1832. In such a colony the same phenomena are exhibited only in a hydrodeme. Polymorphism and the division of physiological labor lead in the first place to the formation of a sensitive and buccal region—the head. We have often seen the appearance of a reproductive region which is capable of isolating itself, as in the medusæ, and exhibits characters that are quite peculiar. In most cases, however, things do not go so far as this. Back of the head there forms simply a locomotive region or thorax, a visceral region or abdomen (Fig. 15), and more rarely an attenuated region or tail. These regions often possess a certain physiological autonomy. From this point of view they may be considered as zooids, and consequently the upper metamerid organisms have the rank of demes.

The linear arrangement singularly facilitates in such demes the grouping of the similar parts of the merids in these sorts of syndicates or corporations, which are the tissues, the organs and the apparatus. The material relations are established by a circulatory system, and the relations of co-ordination by a nervous system, an undivided property among all the merids, and the unity of which completely assures the solidarity of all the parts. In the highest vertebrates there is even produced an extreme centralization, which they pay for by a fragility that is relatively greater than that of the lower vertebrates.

This centralization in the vertebrates does not prevent the constituent merids of the body from remaining clearly distinct, as is shown by the entire organization of the lower vertebrates and the method of development of the higher ones. There are, on the contrary, cases in which certain conditions of existence (parasitism, fixation to the ground, habitation in the interior of a shell or hole, etc.) may lead to the fusion of all the merids into a single undivided body. The Gephyrians, the flat worms, the Arachnids and the parasite Crustacea show us all the phases of such fusion, which is almost entirely realized in the Nematoids and Mollusks.

On another hand, owing to tachygenesis, favored by the accumulation of a larger or smaller quantity of nutritive material in the egg, the precocious birth and the slow development, merid by merid, of the lower forms are replaced by so rapid a development that all the pieces of the organism seem to form almost instantaneously, and that the latter leaves the egg with its definite form, having nothing further to do but to grow.

Here, then, we are in possession of a mechanism owing to which all the successive stages of the organic complication may be easily chained one to the other. Were the first organisms simple plastids, as are now all individuals at the beginning? There is no reason why the same mechanism should not have been applied to the gradual formation of organisms in the course of time gone by, and be applied to the present formation of individuals. There exist, then, necessary ties between paleontology and the comparative morphology of the present forms and their embryogeny.

If there still exists any doubt as to the first causes of budding, there is no doubt about the fact itself, and it suffices to establish the proposition that the victory of organisms in the struggle for existence has been obtained by association. The associations have been gradually fortified by reciprocal sacrifices that have been made by individuals, without, however, ever abandoning their personality, save in a few degraded types. Discipline, the constitution of common organs and that of social reserves, accompanied always with personal reserves often transmitted hereditarily, have been the most active factors of improvement. Upon the whole, it is therefore the practice of what we call social virtues that has made organisms powerful and assures their duration. It would be easy to establish the fact that, when once the form of the body was realized, force began constantly to succumb to intelligence. It was by the great development of their nervous system that the vertebrates first characterized themselves, and in this respect they did not cease to progress until human reason finally dominated the organic world. The doctrine of evolution, then, does not, as might be thought by superficial readers of Darwin, afford any support to those who believe in the exclusive triumph of material power, and who have got into the habit of glorifying self, in excusing themselves on the plea of the necessities of the struggle for existence. The history of the living world, on the contrary, shows us intelligence everywhere triumphant, and association (that is to say, the constant sacrifice of a portion of one's personality) as the essential condition of progress, even in material well-being. This history teaches us solidarity before all things, and no lesson could be more consoling at an epoch in which so many minds have closed themselves to other light.—Edmond Perrier, in La Revue Larousse.

VITALITY OF SEEDS.

"M. C. De Candolle," says Cosmos, "in presenting some considerations to the British Association relating to his experiments on the vitality of seeds, cited several curious facts that it may be interesting to mention. Thus he related the fact observed in Greece, where, after removing the refuse of a silver mine that had been long unworked, the workmen saw a whole flora appear, evidently from seeds that had been buried under the debris and that must have been so buried not less than 1,500 years. One of M. De Candolle's hearers, an Irish farmer, then mentioned an analogous fact: he had noticed that certain fields that had been uncultivated from time immemorial became covered, as soon as they were tilled, with the wild poppy. It would be interesting to know whether the poppy had not been growing near by; the fact would not be comparable with that related by M. De Candolle unless no poppies were to be found in the vicinity. Another auditor, Mr. Seward, a distinguished paleobotanist, says the Literary Digest, remarked that facts of the same kind may have taken place long ago; he thought, in fact, that seeds covered by the glaciers of the ice age may have preserved their vitality and may have germinated centuries later after the retreat of the glaciers."

TREVORIA CHLORIS.

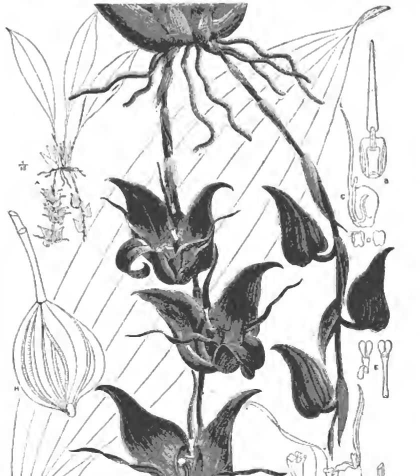
This is the second of a number of new genera of orchids which I have discovered during the twenty-one years of my travels in the Andes. Both Trevoria and my Gorgoglossum are old acquaintances of mine, but owing to their great rarity, and their growth in habitats very difficult to reach, insufficient floral material have made it hitherto impossible to publish them.

Gorgoglossum Reichenbachianum, Lehmann (MS., 1879), was met with in December, 1879, in one single specimen on the Western Andes of Ecuador, at an elevation of 300 to 600 meters above sea level. The single specimen was duly given to the late Professor Reichenbach; but the flowers having lost their pollinia, he did not venture to describe the plant, and it wandered with some 3,000 other numbers of the herbaria for twenty-five years to the grave at Vienna. Some eleven years later, when I knew already the fate of my unique Gorgoglossum, I undertook an especial journey to the locality in order to secure a few plants for cultivation in one of my estates in the Cauca. Only five plants were found, of which to-day one exists in my possession and another in that of Sir Trevor Lawrence, the rest having been lost on the sea voyage.

My first acquaintance with Trevoria occurred in 1887. Only three specimens were seen, bearing thin, drooping spikes, about 40 cm. long, of thickly-set seed vessels, but no flowers. The plants I tried to take to the Cauca for cultivation, but, alas! they were stolen from me by some rascal at Esmeraldas during my absence from the steamer, together with a number of other botanical treasures. Nothing more was seen or heard of this plant, which, by the by, looked quite novel and interesting until last year, when during an exploration of a certain portion of the Western Andes of Colombia, with a view of projecting a map on behalf of the Cauca government, a few plants of this species of orchid were observed. The species found in Colombia is, however, quite distinct from that of Ecuador. The latter grows at an elevation of 500 meters above the sea, and produces flower spikes of from twenty to thirty flowers, the size and character being as yet unknown, while the Colombian one inhabits a region from 1,500 to 1,700 meters above the sea (as far as observed), and bears racemes of only three to five, commonly only three flowers.

As a genus, Trevoria is very characteristic and distinct. Its nearest neighbors are Coryanthes, Schlimia, Stanhopea, and Gorgoglossum, but it is distinguishable at first sight from either of them. Trevoria chloris produces large fleshy wholly green flowers, placed on the drooping spike in the manner of the buckets on a dredger chain. The narrow disk of the lip and the thick coriaceous process at its base are the only different colored organs in the flower; they are pure white. Both from a morphological and also from a physiological point of view this genus is very novel and interesting. The position of the column and lip, standing straight upright in an urceolate manner, the thick fleshy process at the base of the lip being of exactly the same length as the column, and standing parallel and closely adpressed to that organ, the peculiar shape and insertion of the stigma and several other items are wholly novel, and the arrangement of them to each other may set at naught some of the pet views of modern hypercritical speculators with respect to the aid of insects in the fertilization of orchids, or give rise to quite new conceptions.

I have named this genus of Orchidaceæ in honor and commemoration of Sir Trevor Lawrence, one of the most enthusiastic orchidists that ever lived. Trevoria has to answer our purpose; Lawrencia and Lawrenceella being already in existence in Compositæ and Malvaceæ respectively. May Sir Trevor's love of orchids perdure sempervirent as Chloris the goddess of flowers. Popayan, February, 1897. F. C. Lehmann.—The Gardeners' Chronicle.



TREVORIA CHLORIS—FLOWERS GREEN.

A. plant reduced to show habit; B, C, lobes of the lip; D, anther cap; E, pollinia and caudicle; F, lip detached (seen from the side); G, clinandrium; H, capsule.

AMERICAN TEA CULTURE.

Secretary of Agriculture Wilson has received a report from a veteran horticulturist whom he sent recently to investigate the tea farming industry carried on at Summerville, S. C., with a view to ascertaining the prospects of profitable growth of the tea plant in this country, should it be decided to introduce it here as an industry.

The report says the labor question is the most important one in the economics of this business in this country. It estimates the minimum cost about eight times as much to pick one pound of tea in South Carolina as that paid for the same service in Asia. The report suggests that it seems impracticable to compete with the cheap Oriental labor, and while some of the processes of development have been delegated to machinery, the picking of the leaves, requiring discrimination in selection, has to be done by hand. The problem has been ingeniously met in this Southern field by establishing a small colored school where tea picking is included in the curriculum, and the young scholars, after some instruction, prove good pickers.

As to the future of tea culture in the United States and the encouragement for its extension, the report

quotes the promoter of the South Carolina tea fields as saying that if he were twenty years younger, he would plant 500 acres as rapidly as he could procure the plants, thus indicating his faith in tea raising as a profitable industry. The report urges the development of knowledge as to tea raising by means of schools of instruction.

LIFE ON THE PLANETS.

By M. J. Janssen.*

(Having shown how all astronomical discovery, concluding with spectrum analysis, points to a similarity of constitution in the earth and the heavenly bodies, M. Janssen continues:)

All this whole forms a single family, the members of which have a common genesis and have been formed with the destiny of becoming worlds like ours. Their movements around the central star which enchains them by its powerful attraction are subject to the same laws, and that star, by virtue of its high temperature and the immense reserves of force it contains, sheds upon them those influences and radiations which go to place upon their surface the generative elements of life. Yet while these stars present so strict analogies in formation and nature, they do not by any means indicate the same degree of advancement in what may be called geological or rather planetary evolution, or that which tends to the appearance and development of life on their surface. Here the conditions of mass, of distance from the sun, and doubtless other circumstances still unknown, come in to order the epoch and extent of these developments; but we can affirm, without going beyond the inductions permitted by the condition of science, that if life has not yet been established directly on the surface of any of the planets, we have very strong reasons for assuming its existence on some of them. We may regard this conclusion as gained from the long labors of antiquity and modern discoveries.

We say that, while the problem has not been directly resolved by the eyes, it has been worked out by an aggregate of facts, analogies, and rigorous deductions that leave no room for doubt. This is the mature and perfect fruit of science. It is the view of intelligence, as certain an authority and of even a higher and nobler order than the senses. I say further that what we know of the unity of the chemical composition of the matter of the sun, the stars, and the nebulæ permits us to make new inductions respecting the part performed by the bodies which are on the earth the most important factors of the phenomena of life. It is thus infinitely probable that hydrogen, oxygen, nitrogen, carbon, and especially water, which on the earth are the indispensable constituents of vegetable and animal life, fill a like office not only in the planets of our system, but throughout the universe.

Water in particular, by virtue of its chemical functions and the properties with which it is endowed in the solid, liquid, and gaseous states—properties which are so admirably fit for the accomplishment of physiological processes—is a unique substance, and the search through the whole series of chemical compounds for any body that can take its place has been in vain. The discovery of the spectrum of the vapor of water permits us to deduce and assert its presence in the atmospheres of the planets and in those of a whole class of stars as well. Drawing from these results the fact of the presence of hydrogen, one of the generative gases of water, in nearly all the stars, we are justified in supposing an extreme diffusion of that important element from the point of the unity of the phenomena which control the production and maintenance of life.

Thus, the more science advances, the more is that great law confirmed and established of unity in the material elements, in the compounds formed of those elements, and in the constitution of the stars and the parts they perform in the grand whole.

Are we authorized now to assume from this a unity of forms that life may put on not only in the sister planets to ours, but also in the other systems of worlds scattered through the skies? May we especially push our inductions still farther and higher, conclude from such material unity upon a mental and moral unity, and say that, as there is only one physics and one chemistry in the universe, there are also only one logic, one geometry, and one moral, and that the beautiful, the good, and the true are identical aim of the universal order everywhere?

Science, embracing in its results only immediate and demonstrated facts, does not warrant us going so far as this, but with the truths it unfolds to us seems to invite us toward it.

There were brilliant minds in antiquity, which, upon bases otherwise restricted, conceived and proclaimed verities concerning the world and the universe which the most modern science has only been able to confirm.

Let us, then, respect these cheerful speculations. If they are still only of things preconceived, who can affirm that science will not make them real to us tomorrow? By establishing the laws and harmonies of the material world, astronomy prepares us for the conquest of truths of a still higher order.

We can say then plainly that the subjection of natural forces and the reign of man over Nature are only the first fruits of science. It prepares other fruits for its votary of a higher and more precious order. By the beauty of the studies to which it invites him, by the grandeur of the horizons which it opens to him, and the sublimity of the spectacle it gives him of the laws and harmonies of the universe, it promises to win him away from his present preoccupations, which are perhaps too exclusively positive, and will restore to him under a new form and in an incomparable grandeur that taste for elevated poetry, that enthusiasm for the beautiful, and that reverence for the ideal which are among the most imperious needs of the human soul and which it never abandons without peril.

The English war office authorities are a good deal troubled over the results of using cordite for artillery. At a recent practice at Okehampton, out of eighteen guns of the Horse Artillery using cordite in place of ordinary powder, seven guns became useless after firing only two rounds each.

* From his remarks at the annual meeting of the French Academy of Sciences, October 21, 1896.—Translation from the Revue Scientifique by Popular Science Monthly.

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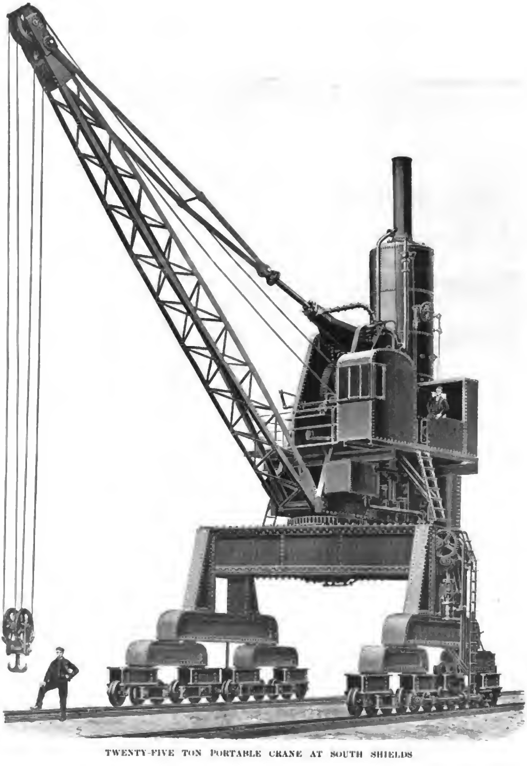


TWENTY-FIVE TON PORTABLE CRANE AT SOUTH SHIELDS

TWENTY-FIVE TON PORTABLE SELF-PROPELLING STEAM CRANES AT SOUTH SHIELDS.

WE illustrate herewith one of two cranes which have just been erected and tested on the new wharf belonging to the Harton Coal Company (Limited), at South Shields. The wharf, which is of wood, has a frontage of about 600 ft. to the river, and has been constructed to the designs of Messrs. Sandeman and Moncrieff, C.E., of Newcastle-on-Tyne, who also prepared the general specifications for the cranes. In these it was provided that the load should be lifted at 60 ft. per minute, and that the crane should be capable of making a complete revolution in 30 seconds. A calculated factor of safety equal to 8 was specified for all parts, while under maximum load the pressure between the wheels and the rails was not to exceed 10 tons. It was further provided that the center of gravity should not deviate more than 3 ft. 3 in. from either side of the center of revolution with the load on or off. The general appearance of the crane is well shown in our illustration. The track on which the crane travels consists of a double rail at each side, with a space between of 2¾ in., the carriage wheels having central flanges. The gage is 21 ft. from center to center of the groove thus formed.

The wheel base is 38 ft. 6 in., there being 12 wheels on each side. These wheels are 2 ft. 6 in. in diameter, and are spaced at 3 ft. 6 in. center to center. The whole of these 24 wheels are fitted with Bessemer steel tires.

Each corner of the carriage is supported on six wheels. The maximum radius of the jib is 35 ft. and the minimum radius 25 ft. The radius is very quickly varied between these extremes, by the arrangement described below. The tie rods suspending the jib are attached to the piston rod of a hydraulic cylinder, which is of Siemens cast steel, lined with copper. There are a pair of double acting pumps with gun metal lined barrels, operated direct from the piston rods of the hoisting engines; these pumps can be readily disconnected when it is not required to vary the jib radius. They draw water from a supply tank and discharge back into the same tank, or at option into the upper end of the hydraulic cylinder. When it is desired to lessen the radius of the jib, the discharge to the tank is closed, and the water acts on the piston and lessens the radius at the rate of 1 ft. per second. The radius is increased by allowing the water to escape to the tank.

The main engines for hoisting have a pair of 16 in. cylinders, and are always in gear with the hoisting barrel, by duplicate steel wheels and pinions, single purchase. The link reversing motion is operated by a steam cylinder very quickly, and with little exertion to the driver. There are also a pair of separate engines for slewing, and a third pair of engines for propelling the crane, this being effected by the vertical shaft and bevel gearing shown in the woodcut. These engines also drive a capstan attached to one corner of the carriage for manipulating the coal wagons on the wharf, and putting them on and off the cradle by which they are lifted and discharged into the vessels.

The body of the carriage is high enough to allow two trains of loaded wagons to pass underneath. The boiler is 21 ft. high and 6 ft. in diameter, and is certified by Lloyd's for 75 lb. working pressure. The total weight of each crane in working order is about 130 tons. The official tests were highly satisfactory in every way, the prescribed conditions being all fulfilled.

The cranes were designed and built by Messrs. George Russell & Company, of Motherwell, near Glasgow.—Engineering.

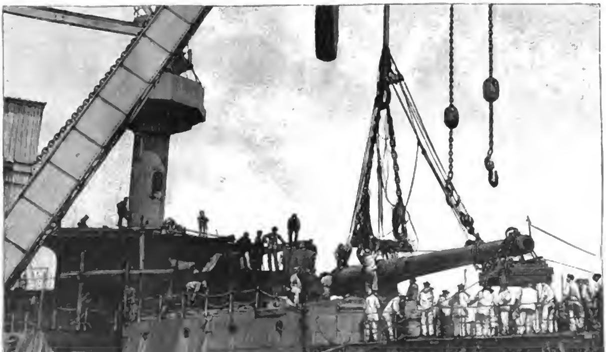
THE DERRICK AND THE TWELVE INCH GUN.

THE BOUVET AND HER NINETY-NINE THOUSAND POUND GUN.

THE French armorclad Bouvet, which, at the beginning of June, entered upon the most active phase of her armament, is one of the most recent and powerful battleships now afloat.

Her high and slightly incurved stem, armed with a formidable ram, her somewhat low, pointed stern, and her rounded sides that bulge at the load water line, represent her well seated upon the water and will certainly contribute toward assuring her stability, even upon the roughest sea.

The [illegible] of the water lines necessary for the speed of 17.5 knots that the vessel must make, and the very compressed form given her topsides at the median part, so as not to interfere with the field of firing of the guns of the side turrets, but to allow them [illegible]



PUTTING THE TWELVE INCH GUN IN PLACE ON BOARD THE BOUVET

to have their maximum effect in direct fire aft and ahead, give this mass of steel of more than 12,000 tons displacement an elegant appearance.

It is especially during this period of armament, while the vessel, still light, is sitting high above the water and thus showing her entire belt of armor, that it is possible to obtain an idea of her great defensive power. This is carried to the extreme on the Bouvet, where the protective belt of more than six feet in height and 16 inches in thickness extends from stem to stern, thus strengthening the ram with its entire mass, but at the stern assuming a very hollow tapering form to prevent the eventual shock in the axis and protect the rudder and three screws.

An armored deck $2\frac{3}{4}$ inches in thickness rests in the form of a turtle's back upon the upper edge of the belt of armor, in order to assure the protection of the most valuable and delicate belongings of the vessel. To prevent the great damage that might be caused by rapid fire light artillery, and by shells filled with powerful explosives, in the immediate vicinity of the load water line, the ship has been covered with a second cuirass, above the principal belt, but only $3\frac{1}{2}$ inches in thickness, and with an armored deck especially designed to prevent the entrance of water and allow the vessel to preserve its equilibrium in case of grave damage being done it.

The offensive power of the Bouvet resides less in the number of her guns than in the extreme care taken to protect them against the fire of the enemy.

The $10\frac{3}{4}$ and 12 inch pieces, which form the most important part of the armament, are each inclosed in a movable turret protected with 14 inch plate and completely closed, and having no other aperture than the one strictly necessary for the muzzle of the piece and for upward pointing.

Our ancestors would be much astonished to see with what ease and rapidity the powerful steam derrick of the port of Lorient, capable of lifting a weight of 150 tons, proceeds to the putting in place of the heavy pieces that enter into the armament of an armorclad. It is child's play for the derrick to seize, upon the wharf, the huge 12 inch gun, weighing 99,000 pounds, and balanced at the muzzle with one or two tons of pig iron, and then, turning upon its rollers, to place the breech opposite the narrow aperture in the turret. Here the final operation becomes original, in the sense that, in order to cause the gun to enter the turret, gangs of men, working at the capstan, are obliged to cause the 12,000 ton vessel itself to move forward until the breech, on entering the fork, hangs over its carriage.

The artillery of the Bouvet will consist of two 12 inch and two $10\frac{3}{4}$ inch guns, eight $5\frac{1}{2}$ inch rapid fire guns, and thirty small pieces distributed here and there upon the bridges and the military mast. It will have two torpedo tubes, and carry a crew of 31 officers and 600 men.—L'Illustration.

USE OF COMPRESSED AIR IN RAILROAD SHOPS.

THE Illinois Central Railroad at their Burnside shops use compressed air for the following purposes:

Elevating sand at engine sand house, elevating oil at oil house, hoisting heavy castings and parts of machine tools, etc., forcing couplings on air hose, operating cylinder boring bar, operating valve facing machine, filling cylinders of hydraulic presses, removing and applying driving tires, testing water pumps after repairs, drilling with motor, tapping with motor, reaming with motor, cleaning boilers, cleaning machinery, punching jacket rivet holes, taking old paint off tin roofs, rolling and beading flues, chipping, cutting, calking, small bull dozer, elevating water from deep wells, testing air and driving brakes, elevators in storehouses, operating letter presses, cutting out staybolt stubs, jacking up cars and trucks, cleaning interior of coaches, cleaning upholstered work, burning paint off coaches, painting cars, sandblast ends of cars, gasoline heater, cutting off staybolts, screwing in staybolts, rivet forges, one blacksmith forge, pressing in driving box brasses, operating flange clamp, swedging flues. They consider it the best means of transmitting power in and about shops.

THE GREATEST STEAMER IN THE WORLD.

THE fourth of May of this year saw the launching of the largest steamer of all merchant navies of the world. The twin screw steamer Kaiser Wilhelm der Grosse was built for the North German Lloyd on the dry docks of the Vulcan, at Bredow, near Stettin. Her length on the water line is 190·5 meters, length over all 198 meters. She is 20·1 meters broad; the height from keel to deck, 13·1 meters. The hold represents a volume of 12,800 tons; the total displacement of the ship is 20,000 tons. The boat is built of steel, according to the rules of the German Lloyd, and under the supervision of the inspectors of the German and North German Lloyds, and ranks among the highest class boats.

All possible measures have been taken for the safety of passengers, cargo, and the boat itself, in accordance with the most modern improvements. The ship's hull contains fifteen watertight bulkheads and one machine bulkhead, on either side of which the engines are located. They are independent of one another. By the bulkheads the Kaiser Wilhelm der Grosse is divided into eighteen separate watertight compartments. Throughout her whole length she is provided with a double bottom.

There are two triple expansion engines, with four cranks and four steam cylinders, which lie one behind the other. Besides the two chief engines there are no less than sixty-eight supplementary engines (for electric light, pumping machinery, etc.), with altogether 124 steam cylinders.

To avoid the rocking and the concussion due to the immense engines, these have been balanced in their parts by the well known Schlick system. The two engines will have a horse power of 30,000. They are fed from fourteen boilers, and burn 450 to 500 tons of coal daily. The speed of the boat will be twenty-two knots. There is accommodation for 400 first cabin, for 340 second cabin, and 800 steerage passengers.

The specially large and elegant saloons, throughout of German workmanship and German materials, are masterpieces of German production. The first saloon is built in Italian early Renaissance style; in the recesses are represented the residences of the emperors from ancient up to modern times.

On either side of the first saloon are attached small drawing rooms. The other rooms are finished partly in Rococo style, partly also in Italian Renaissance and Queen Anne style. There are provided a reading room, a music room, smoking room, etc. All rooms are distinguished by the most artistic furniture of excellent taste and comfort. The cabins hold two or three persons each. Besides there are a few state rooms furnished for special occasions. Essential improvements too are made in the accommodation of the steerage passengers, both in their position and in the space and comforts allowed.

The crew consists of no less than 450 men, of which number 208 are employed in the engine room. The ship carries twenty-four steel boats. Another notable feature are the extensive precautions taken against fire, also the huge pumping plant of the steamer. The boat has two masts, and four immense funnels, which give it a most imposing appearance.

Our cut represents the gigantic steamer standing on end beside the spires of the Cologne Cathedral. It gives perhaps a better idea of the immense length than any other means could convey. We are indebted for the illustration to Illustrirte Zeitung.

THE KAISER WILHELM DER GROSSE AND COLOGNE CATHEDRAL.

A PRESIDENTIAL CAR.

THE Railroad Car Journal has originated a project to build a private car for the President of the United States, from material and appliances contributed for the purpose by the car building and affiliated industries.

It is proposed to construct a private car excelling anything of this kind which has been done before in the substantial character of its construction and in the completeness and convenience of its furnishings and decorations.

The projected car will be a complete exposition of the art of car building, demonstrating to the world the surpassing excellence of this industry in the United States; and it is to be presented to the nation, as a tribute from the car building fraternity, for the personal and official use of the successive presidents.

The designs and specifications for the car are being prepared by the Railroad Car Journal, under the supervision of a committee of twenty-five prominent and representative master car builders and superintendents of motive power of various railroads, thus insuring the end that the proposed car shall represent the skill, ingenuity and experience of the American car builder.

Much of the necessary material required for its construction has been tendered by leading dealers and manufacturers in the railroad supply trade, and the projected movement offers an exceptional opportunity to firms engaged in business which, while not directly associated with the car building industry, make and supply various articles and materials which will be desired for the furnishing and decoration of so elaborate a vehicle as a private car for the use of the President of the United States.

Offers of contributions of material, furnishings, appliances or utensils should be forwarded to the Railroad Car Journal, New York, for submission to the advisory committee.

A RAILWAY HOSPITAL CAR.

CONSUL MORRIS writes from Ghent: The latest novelty in Belgian railroad matters is the hospital car. It serves a double purpose. In the event of a serious railroad accident, the car may be run to the spot, where the wounded may be picked up and carried to the nearest large city for treatment, instead of being left to pass long hours in some wayside station while awaiting surgical attendance. It also enables the railway companies, at certain seasons or upon special occasions, to transport large numbers of invalids to health resorts or places of pilgrimage. This new hospital car entered into regular service April 27, 1897. The interior is divided into a main compartment, a corridor on one side, and two small rooms at the end. The largest compartment is the hospital proper; it contains twenty-four isolated beds on steel tubes hung upon powerful springs. Each patient lies in front of two little windows, which may be closed or opened at will. Each bed is provided with a little movable table and a cord serves to hold all the various small objects which the patient may need.

The corridor on the outside of the hospital chamber leads to the linen closet and the doctor's apartment. In the latter is a large cupboard. The upper portion is used for the drugs; the lower part is divided into two smaller compartments—one serving as a case for

surgical instruments, the other as a receptacle for the doctor's folding bed. The hospital compartment is carpeted with linoleum or other material to deaden the sound of walking. Various trapdoors in the floor, when opened, disclose to view an ice chest, a compartment for the disinfection of soiled linen, and a provision cellar. If necessary, a portion of the hospital chamber may be transformed into an operating room for urgent cases. Finally, as is customary in this country, a small chapel for religious worship is provided. This car will be put in charge of a surgeon, doctor and nurse, and will be chiefly used to carry invalids from Belgium direct to the miraculous cure of Lourdes, in France. The feasibility of the introduction of such a hospital car on American railroads seems to me beyond question; if run, for instance, during the winter season between any one of several Northern cities and certain well known Southern resorts, it would, without doubt, be well patronized.

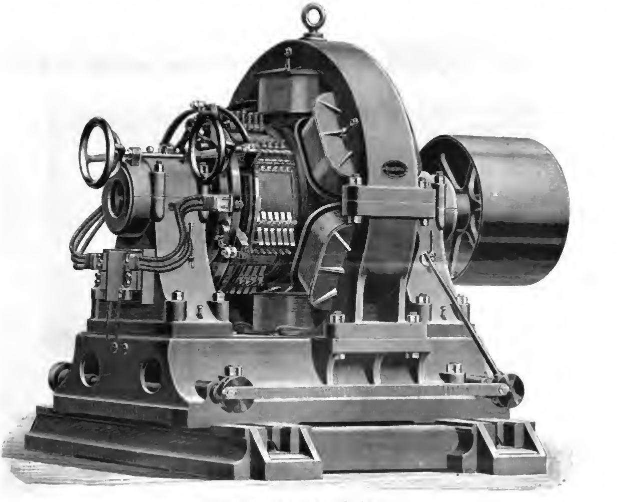
SIX-POLE SEVEN-KILOWATT DYNAMO.

WE illustrate herewith a six-pole dynamo, constructed by the Electrotechnische Industrie (formerly Willem Smit & Co.), of Slikkerveer, Holland. The dynamo in question has been designed to give a current of 600 amperes at 120 volts when running at 450 revolutions per minute. The general arrangement is very clearly shown in the woodcut. As will be seen, the dynamo is belt-driven, and mounted on a cast iron bed, along which it can be traversed by screws when it becomes necessary to tighten the belts. These screws are coupled together, so that a uniform traverse is automatically secured. The armature shaft runs in bearings of ample proportions, while efficient lubrication is secured by a loose ring mounted on the shaft and dipping into an oil bath, the level of the lubricant in which is shown by gage glasses. The field magnets are formed out of steel castings, the pole pieces being cut out of a separate complete steel ring, and bolted into place. The magnetizing coils are wound on iron spools having end flanges of bronze.

The bearing surfaces are of white metal. The armature is of the Gramme type, and is mounted on a six-armed spider of bronze. These arms are sufficiently long to carry the commutator, which thus makes one piece with the armature proper. The body of the latter is built up of extra soft steel stampings half a millimeter thick, paper being used as the insulator. These plates are stamped in two operations, the first of which produces the central hole and the notches for the spider arms, while the second produces the grooves in which the windings are laid. The whole set of stampings are kept together, not by bolts as usual, but by riveting the horns of a bronze end flange to the corresponding arms of the spider, this work being executed while the disks are heavily pressed together. The winding is laid in 200 narrow slots, in each of which are laid six wires, 3 millimeters in diameter, connected up in multiple arc, and carefully insulated.

The commutator bars are of hard drawn copper, insulated with mica, and the diameter of the commutator is, it will be seen, nearly equal to that of the armature itself. Connections of tinned copper are used between these bars and the armature windings. The number of commutator bars is equal to that of the windings, so that the current delivered is extremely steady. These bars are held in place by a clamping ring, and the depth allowed for wear above these rings is about $1\frac{1}{8}$ in. Mica is used exclusively for the insulation of this important part of the machine.

The armature is not keyed on the shaft, but is secured entirely by friction, two iron rings being shrunk over the ends of the spider tube. End motion of the armature when running is limited by a screwed ring shown at the pulley end of the shaft. There are six sets of six brushes each, and the bearing pressure of each separate brush can be adjusted independently of the rest. At the same time by means of one small handwheel all the brushes can be simultaneously raised from or lowered into contact with the commutator, while a second handwheel provides a means of shifting them round through a small arc, so as to find the non-sparking position. Flexible connections are, it will be seen, used between the brushes and the terminals of the machine. The current required for the field magnets is 12 amperes, or 2 per cent. of the total output of the machine.



SIX-POLE SEVEN-KILOWATT DYNAMO.

POWER REQUIRED FOR ELECTRICALLY OPERATED WOODWORKING MACHINERY.

THE following is an interesting report of some electrical tests upon the power required for running woodworking machinery, made by Prof. O. G. Dodge, U. S. N., the work having been done at the navy yard at Washington, D. C. It should be borne in mind that a watt is a volt ampere, and equal to $\frac{1}{746}$ of a horse power. An electrical horse power is equal to the product of the current in amperes and the difference of potential in volts divided by 746. One horse power equals 746 watts, which is the equivalent of 33,000 foot pounds per minute. The results are reproduced from the Electrical Engineer.

In the case of the following tests the mechanical horse power delivered by the motor was determined by tests made under the same conditions as the previous power tests. This was necessary, as in many cases long leads were run to the motor, and the drop was large. In other cases it was necessary to use a rheostat in series with the armature to obtain the required speed. Under these conditions the efficiency of the motor was a variable factor, and a separate test was made in each case to determine the output of the motor. The column of mechanical output is therefore the proper one to use in determining the motor required, and the electrical horse power to be delivered by the generator. The work done is the heaviest required of these particular machines:

Circular rip saw, 28 in. diameter; speed, 1,200 revolutions per minute, or 8,800 lineal feet per minute; arbor pulley, $5\frac{1}{4}$ in. diameter by $8\frac{1}{4}$ in. face; hand feed; motor belted to saw shaft. Motor and saw, idle, 3·4 E. H. P.; ripping seasoned heart oak, $7\frac{5}{8}$ in. thick; feed, 10 ft. per minute, 19·3 E. H. P.

Circular rip saw, 34 in. diameter; speed, 1,500 revolutions per minute, or 9,429 lineal feet per minute; hand feed; motor belted direct to 7 in. pulley on saw shaft. Motor driving saw, idle, 3·2 E. H. P.; ripping seasoned heart oak, 6 in. thick, 10 ft. per minute, 12·8 H. P.; ripping seasoned white pine, $6\frac{1}{4}$ in. thick, 15 ft. per minute, 9·4 E. H. P.; ripping seasoned yellow pine, 2 in. thick, 45 ft. per minute, 10·7 E. H. P.

Circular rip saw, 14 in. diameter; speed, 2,200 revolutions per minute, or 8,067 lineal feet per minute; arbor pulley, 8 in. diameter, 5 in. face; hand feed; motor belted to saw shaft. Motor, idle, 0·96 E. H. P.; motor and saw, idle, 2·7 E. H. P.; ripping seasoned heart oak, $8\frac{1}{4}$ in. thick, 12 ft. per minute, 6·3 E. H. P.

Circular rip saw, 12 in. diameter; speed, 2,200 revolutions per minute, or 6,914 lineal feet per minute; hand feed; belt pulley, $3\frac{1}{2}$ in. diameter, and 8 in. face; motor belted direct to $3\frac{1}{2}$ in. pulley on saw shaft; saw set to wabble for cutting grooves. Motor, idle, 0·96 E. H. P.; driving saw, idle, 2·2 E. H. P.; cutting groove in seasoned walnut, $\frac{5}{8}$ in. by $\frac{7}{8}$ in., 12 ft. per minute, 3·6 E. H. P.

Band saw pulleys, 72 in. diameter; speed, 160 revolutions per minute, or 3,017 lineal feet per minute; belt pulley, 30 in. diameter, 8 in. face; power feed; motor belted to saw shaft. Motor and saw, idle, 12·1 E. H. P.; ripping seasoned ash, $10\frac{3}{4}$ in. thick, feed 6 ft. per minute, 16·1 E. H. P.; ripping seasoned white pine, $16\frac{3}{4}$ in. thick, feed 10 ft. per minute, 16·1 E. H. P.; ripping yellow pine, 12 in. thick, 20 ft. per minute, 18·8 E. H. P.

Band saw pulleys, 42 in. diameter, speed, 350 revolutions per minute, or 3,850 lineal feet per minute; belt pulley, 16 in. diameter, 5 in. face; hand feed; motor belted to saw shaft. Motor, idle, 0·96 E. H. P.; motor and saw, idle, 2·9 E. H. P.; ripping seasoned oak, 12 in. thick, feed 3 ft. per minute, 5·7 E. H. P.; cross cutting seasoned oak, 8 in. thick, feed 5 ft. per minute, 5·7 E. H. P.; ripping live oak, 10 in. thick, feed 3·2 ft. per minute, 5·7 E. H. P.

Band saw pulleys, 28 in. diameter; speed, 480 revolutions per minute, or 3,520 lineal feet per minute; belt pulley, 12 in. diameter, $3\frac{1}{4}$ in. face; hand feed; motor belted to saw shaft. Motor, idle, 0·96 E. H. P.; motor and saw, idle, 1·7 E. H. P.; ripping seasoned oak, 3 in. thick, feed $2\frac{1}{2}$ ft. per minute, 2·3 E. H. P.; ripping seasoned pine, 3 in. thick, feed 4 ft. per minute, 2·8 E. H. P.; cross cut seasoned oak, $3\frac{1}{4}$ in. thick, feed 4 ft. per minute, 2·3 E. H. P.

Daniel's planer, machine bed, 2 ft. 5 in. by 21 ft. 6 in.;

belt pulley, 13 in. diameter by $5\frac{1}{4}$ in. face; speed, 850 revolutions per minute; speed of cutting edges of tool, 10,400 ft. per minute; power feed, 12 ft. per minute; motor belted to countershaft. Motor idle, 0·96 E. H. P.; driving machine, idle, 3·9 E. H. P.; planing seasoned oak, cut $\frac{1}{8}$ in. deep by 20 in. wide, 12 ft. per minute, 6·2 E. H. P.

Hand cylinder planer or jointer, size of machine, 24 in.; belt pulley, 4 in. diameter, 5 in. face; speed, 3,200 revolutions per minute; speed of cutting edge of tool, 4,000 ft. per minute; hand feed; motor belted to shaft of tool. Motor, idle, 0·96 E. H. P.; driving machine, idle, 2·40 E. H. P.; planing white pine, cut $\frac{1}{16}$ in. deep by 18 in. wide, 25 ft. per minute, 4·80 E. H. P.

Cylinder planer, size of machine, 24 in.; belt pulley 5 in. diameter, 5 in. face; 2,250 revolutions per minute; speed of cutting edges of tool, 3,105 ft. per minute; power feed; motor belted to shaft of tool. Motor, idle, 0·96 E. H. P.; driving machine, idle, 2·40 E. H. P.; planing pine, cut $\frac{1}{8}$ in. deep, 18 in. wide, 11 ft. per minute, 3·6 E. H. P.; planing oak, cut $\frac{1}{8}$ in. deep, $6\frac{1}{2}$ in. wide, 11 ft. per minute, 3·6 E. H. P.

Boring machine, speed of bit, 375 revolutions per minute; hand feed; motor belted to bit shaft. Motor, idle, 0·96 E. H. P.; driving machine, idle, 1·7 E. H. P.; boring 4 in. hole in seasoned oak, $9\frac{1}{2}$ ft. per minute, 2·3 E. H. P.

Boring machine, belt pulley, 8 in. diameter, 3 in. face; speed, 750 revolutions per minute; hand feed; motor belted to machine shaft. Motor, idle, 0·96 E. H. P.; driving machine, idle, 1·9 E. H. P.; boring 1 in. hole in oak, feed, $3\frac{1}{2}$ in. in 5 seconds, 2·2 E. H. P.; boring $1\frac{3}{8}$ in. hole in oak, feed 1 in. in 7 seconds, 3·2 E. H. P.

Pattern makers' lathe, speed, 888 revolutions per minute; motor belted direct to lathe. Motor, idle, 0·96 E. H. P.; driving lathe, idle, 2 E. H. P.; turning seasoned poplar, 12 in. diameter, $\frac{1}{4}$ in. cut, 8·2 E. H. P.

Carver and moulder, speed of tool, 5,200 revolutions per minute; motor belted direct to tool shaft. Motor, idle, 0·96 E. H. P.; driving tool, idle, 2·8 E. H. P.; cutting groove, circular sector, 2 in. wide, $\frac{3}{4}$ in. deep, $8\frac{1}{2}$ ft. per minute, in white pine, 3·9 E. H. P.

ELECTRICAL PLANT, LONDON CENTRAL RAILWAY.

MESSRS. ERNEST SCOTT & MOUNTAIN have supplied to Messrs. Walter Scott & Company the electrical plant illustrated by the accompanying engravings. In all six engines have been provided, these being fixed at the various stations. Each engine is of Messrs. Scott & Mountain's improved compound central valve, inclosed, self lubricating type, and capable of giving 35 effective horse power with a steam pressure of 120 lb. per square inch when running at a speed of 350 revolutions per minute. The engines are fitted with cylinders of the following dimensions: High pressure cylinder, 7 in.; low pressure, 12 in.; stroke, 6 in. The central valve placed between the high and low pressure cylinders has been specially designed to avoid friction, the valve being balanced, while the arrangement of the ports reduces clearance. The central valve admitting steam to the high and low pressure is worked from one eccentric and rod, the cranks being placed opposite. A special oiling arrangement is provided, consisting of a pump worked from the eccentric rod, and arranged to deliver oil through all bearings under pressure. Suitable doors are provided for the examination of the engine while running or for adjusting brasses. All the bearings are lined with white antifriction metal, and the bearing surfaces throughout are very large. The speed of each engine is controlled by a governor attached to a crankshaft working on to an equilibrium throttle valve, and suitable means are provided so that the speed of the engine can be adjusted while running.

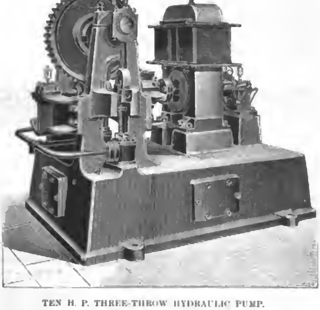
Six dynamos in all are provided, these being used for working the electric locomotives, hydraulic pumps for the shields, and also for lighting purposes. The dynamos are fitted with Gramme armatures, each machine being constructed to give an output of 100 amperes and 200 volts when running at a speed of approximately 700 revolutions per minute. The machines are compound wound, self regulating, and are fitted with adjustable bearings. On reference to the illustration it will be noticed that the height from the bottom of the bedplate to the center of the armature spindle is kept as low as possible to avoid all vibration. The dynamos are mounted upon sliding bedplates with tightening screws and brackets, enabling the slack of the belt to be taken up while running.

The current from the dynamos is taken to main switchboards, on which the instruments are mounted for reading the amperes and volts and distributing switches, and are arranged so that the current is divided into the various circuits, i. e., the locomotive circuit and also the lighting circuit.

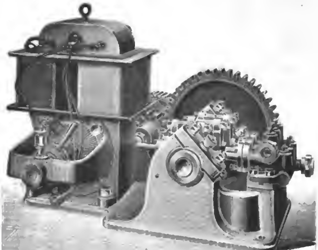
Five sets of hydraulic pumps have been provided in all; four sets are similar to that above, and consist of 3-throw hydraulic pumps with rams $1\frac{1}{2}$ in. diameter by 4 in. stroke, arranged to run at a speed of 100 revolutions per minute, driven by an electric motor of 10 effective horse power. On reference to the engraving it will be noted the baseplate forms the tank, which holds sufficient water for filling the hydraulic cylinders, the water being run back into the tank through a waste pipe and used over again. The worm gear consists of a machine cut steel worm and phosphor bronze machine cut worm wheel, the makers having found this type of gear when properly constructed is most suited for this class of driving, and forms a very compact arrangement. A set of hydraulic pumps similar to that above have been provided for working the small shields. The pumps are fitted with rams $1\frac{1}{4}$ in. in diameter by 3 in. stroke, and are driven by an electric motor of 6 effective horse power through machine cut spur gearing.

Six electric locomotives in all have been provided, the locomotives being in accordance with our engraving. The locomotive frame is of cast iron, and carries the electric motor, which is of 35 effective horse power, this power being provided to enable the locomotives to run at a high speed up to 1 in 30 incline. The electric motors drive through machine cut worm gear, the worm being of steel and the worm wheel of phosphor bronze treble threaded and running in an oil bath. The worm wheel is mounted on one of the crank axles, and the axles are coupled together by connecting rods. Each locomotive is complete with over-

STANDARD DYNAMO.



TEN H. P. THREE-THROW HYDRAULIC PUMP.



THREE-THROW SIX H. P. PUMP.

ELECTRIC LOCOMOTIVE.

head collecting gear for collecting the current from the overhead copper conductor, also stopping, starting, and reversing switches. On each of the electric locomotives are fitted electric bells and horns.

The electric lighting of the tunnels and surface work is very complete; 16 candle power 200 volt incandescent lamps are used, the lamps being placed in wire protection guards, and suspended from the roof or otherwise as found most convenient. The use of electricity has been found of very great advantage in connection with this contract on account of the much purer atmosphere.—The Engineer.

WIRE BUILDINGS FOR TELEPHONES.

By HERBERT LAWS WEBB.

EVERY large office building that is put up to-day should be fully wired for telephone service. Telephone communication is almost as much of a business necessity to-day as ink and paper, and no modern building can be quite modern, and thoroughly up to date, in which provision is not made for supplying telephone communication to every room. At present, it is true, it is rather the exception to find an office building properly wired throughout for telephone connections, but in a few years the exceptions will be those that are not so wired. The demand for telephone service of all kinds is increasing so rapidly that owners of buildings cannot afford to expose their tenants to the delays and inconveniences incident to running wires through large buildings every time a new telephone service is required. A well designed substantial system of telephone wiring is therefore a necessity in the modern office building, in the modern hotel, in the modern factory and even in the modern club or large residence. The architect who would keep abreast with the requirements of the day cannot afford to neglect this.

There are three requisites that a system of interior wiring should fulfill. These are: 1, that the wires should be suitable for telephone working; 2, that they should be accessible to allow of additions, withdrawals or repairs; 3, that they should all terminate at one central point.

The requirements of clause 1 are not difficult to meet. They demand that every circuit shall be metallic and that the two sides of the circuit shall be twisted together with not less than four twists to the foot. This arrangement of the circuit tends to neutralize the disturbing effects of currents that may be circulating in neighboring wires. As to the size of wire, No. 10 B. & S., insulated to $\frac{3}{32}$ with a good quality of waterproof compound, is sufficiently substantial. But let it be a good quality; beware of cheap insulated wire, for it is the dearest in the end. It is a good plan to have the two wires of the twisted pair of different colors, so that they may be readily distinguished at the ends without the delay of testing out.

Clause 2 means, of course, that the wires should be run in conduits or tubing. The era of inflexible and inaccessible systems of wiring has passed. Every kind of wiring that is done on a large scale should be arranged so that the wires can readily be got at for inspection or repairs, readily withdrawn or added to without disturbing walls, partitions or flooring. Such accessibility and flexibility can only be secured by the use of conduit tubing.

The concentration of all the different circuits at one point is a sufficiently obvious necessity to need no elaboration. The wires should all be taken to a terminal or cross connecting board by means of which connection may readily be made with the trunk lines from the telephone exchange. The cross connecting board will also serve to connect together circuits from different rooms in the event of permanent communication being required between offices in the same building.

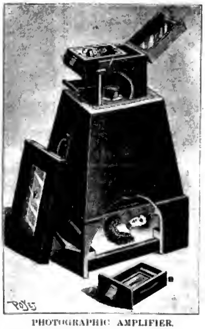
A complete system of telephone wiring laid out in accordance with the general requisites outlined above is a very important and valuable adjunct to the modern office building.—Architects' Electrical Bulletin.

SUBURBAN RAILWAY STATIONS.

THE contrast between Boston's and Philadelphia's artistic suburban railway stations and approaches and the things which do duty as such along most of the lines leading out of New York is as striking as mortifying to the resident of the metropolis. The movement of population at the larger cities is to the neighboring towns, no better illustration of which is found than in the ebb and flow of the tide of nearly 200,000 commuters into and out of New York City daily. Neither Boston, Philadelphia nor Chicago, with incoming and outgoing business populations, compares with New York in the extent to which it attracts commercial, industrial and financial pilgrims daily, yet New York, relatively and absolutely, is worse off than the first two, and hardly any better off than Chicago, as to attractive railway stations at nearby points. There is some attempt by the New York Central and New England lines leading out of New York to beautify suburban railway stations and their surroundings, and across the Hudson the New Jersey Central is conspicuous for the success of its efforts in this direction. The Pennsylvania Railway's artistic railway stations and attractive approaches in the vicinity of Philadelphia have helped to give that company the enviable international reputation it enjoys. In the immediate neighborhood of Jersey City the Pennsylvania has less opportunity to encourage suburban development by beautiful stations in the midst of wide-stretching greenswards and winding driveways than most of the roads running out of Jersey City. Among those from which much is expected, the Delaware, Lackawanna & Western is the most conspicuous offender. Even the Erie, of which much is seldom expected, is building a worthy structure for its patrons at Rutherford, and is soon to put up adequate stations at Passaic and at Paterson. But the Lackawanna prefers, apparently, to cling to the unclean shed which constitutes its station at Newark, and its incongruous buildings and unsightly surroundings at Summit and at Morristown and elsewhere along the line. The hard headed financiers who hold the destinies of the Lackawanna in their hands may be blind to the fact that the expenditure of $100,000 for a new station and the removal of unsightly buildings near it at Summit would increase the value of its own and the town's property many times that amount, and they are undoubtedly oblivious to the fact that an expenditure of enough money at Morristown to create an artistic railway station and in acquiring and improving adjacent property, so as to attract instead of disgusting a new arrival, would redound to the financial gain of the railway as well as of Morristown. But the burden of effort in this direction is not to be thrown upon the railroad company alone. If the residents of the suburban centers referred to do not take enough interest in securing handsome railway stations and approaches thereto, to hold public meetings and use every proper endeavor to secure such advantages, then that public is itself at fault. One would naturally suppose that a railway company, like the lawyer or the merchant, would seek to retain as well as to attract the client, customer or patron, but such a supposition is manifestly absurd with reference to the Lackawanna, which would seem to have searched high and low for all that is unsightly and repellent with which to surround their suburban railway stations or to remodel and utilize as railway stations.—Bradstreet's.

JOUX'S PHOTOGRAPHIC AMPLIFIER.

THE enlarging of a negative is, upon the whole, quite a simple matter, although the operation requires an installation and apparatus devised for the purpose. If a projection lantern be employed, it will be necessary to have a special model that allows no white light to pass, and also to use a condenser that permits of illuminating the negative very uniformly. This is one of the principal difficulties in the work of enlarging by artificial light, the negative to be enlarged being often more strongly illuminated in the center than at the edges. This does not happen with a good apparatus—one that is perfectly adapted to the size of the negative that it is desired to enlarge; but it frequently happens that the operator has a tendency to somewhat force the instrument that he employs, and an apparatus constructed for a $3 \times 3\frac{1}{2}$ in. negative is sometimes used for



PHOTOGRAPHIC AMPLIFIER.

a $3\frac{1}{2} \times 5$ in. one. In this case the results will be defective. From this point of view, the use of daylight is preferable. The installation well made for all sizes of negatives, the illumination is always uniform. On another hand, it is impossible to work at night, and the time of exposure must be varied not only according to the density of the negative, but also according to the state of the sky.

Every medal has its reverse; but, however this may be, it is daylight that has been judged the most practical by manufacturers of small apparatus, and so they have devised special instruments of easy manipulation that permit of operating almost automatically.

We have already described several of these, and now purpose to make known the one manufactured by M. Joux, the maker of the "steno-jumelle."

His apparatus consists of a truncated pyramid, A, upon which is fixed an objective. To the top is adapted a box, B, closed by a cover, V, provided with a ground glass, and which we have here supposed to be open. Just above the objective there is a shutter that slides into the box with slight friction. At the upper part of the box and beneath the cover there is a slide that permits of inserting the frame, C, carrying the negative to be enlarged. This frame has two grooves, which are situated at such a distance from each other that the negative is in focus for a magnification of 5×7 in. when the slide most distant from the objective is used, and of 7×9.5 in. when the nearest is employed. At the base of the box, A, there are two apertures designed to receive a frame with a curtain into which is put the sensitized paper that is to receive the enlarged image. The aperture most distant from the objective is used for dimensions of 7×9.5 in. and the nearest for those of 5×7 in.

The modus operandi is very simple. After the size of the enlargement that it is desired to obtain has been chosen, and a sheet of sensitized paper has been placed against the glass of the frame, in a dark room, the frame is closed and introduced into the apparatus. On another hand, the negative is arranged at the other extremity, as we have already explained. After this, the cover that carries the ground glass and is designed to filter the light and to diffuse it is closed, the curtain of the frame is drawn aside, and the shutter is pulled out. There is nothing to be done now but to point the apparatus toward the sky for a few minutes—from one to ten, according to the negative, the weather and the paper employed. The developing and fixing are done as usual.

The same apparatus may, of course, be used reversibly, that is to say, be made to give small positive images from large negatives. In this case, there are used two frames, D and F, which are represented apart in our engraving.

The small frame, D, has a curtain, and in it (in the laboratory) is placed the sensitized plate that is to receive the positive image designed to be projected. In the frame, F, which is provided with a ground glass, is arranged the 5×7 or $7 \times 9\frac{1}{2}$ negative that is to be reduced. Then each frame is put in place in the apparatus, the apertures into which it is inserted depending, as before, upon the dimensions to be obtained.

After the curtain of the small frame has been drawn aside and the shutter has been pulled out, the large end of the apparatus is turned skyward for a few minutes.

A preliminary experiment is necessary to determine the time of exposure.—La Nature.

SOME NOVEL USES FOR ARTIFICIAL REFRIGERATION.

NUMEROUS special applications of refrigeration have arisen which would scarcely have been suspected until small refrigerating plants were perfected. There are many products, such as oil and chemicals, which are drawn very hot from the stills and retorts, and on which the saving of time by quick cooling more than pays for the cost of refrigeration.

Among these lines of service perhaps one of the most interesting is that of chocolate making. Chocolate was formerly manufactured only in cold weather, when the temperature was low enough for it to be worked and hardened.

A working room temperature of 65° is sufficient for the dipping process and insures the setting of the chocolate when put in the chill room at 45°. If the temperature be much above 65° the chocolate remains sticky and plastic, which is very inconvenient under any circumstances, and absolutely fatal to bonbons.

Cooling coils are placed around the room like steam pipes, but, in addition to this, and of even greater importance, air bunkers are provided, containing ammonia coils, over which the air is forced and cooled. It is then delivered to the room through large galvanized pipes, running across the ceiling, thus providing ventilation for the operatives and the requisite coolness to work the chocolate. The chill room is refrigerated to 45° in the usual way, and opens off the dipping room.

Another one of the many odd uses of refrigeration is in connection with gelatine working. Every one is familiar with the gelatine capsules in which medicine is administered, and will readily understand that difficulty might be experienced in manufacturing such articles in hot and moist weather.

The capsules are formed of sheets of gelatine pressed over steel pins. The cooling must take place rapidly, in order to turn out the product in sufficient quantity, while to insure quality and general evenness of material a proper temperature must be provided.

In one of these instances it was found that about 120,000 cubic feet of air had to be cooled per hour in order to insure an even temperature for the gelatine, and about 100,000 pounds of steel pins per working day had to be cooled from about 90° to 75°. By combining the two requirements and making the blast of cold air cool the pins, both of these results were effected through one operation, requiring only the cooling of sufficient air in bunkers with refrigerating coils. Perfect success was met, and probably in no other way could so useful a result have been obtained so cheaply.

In the tempering of steel or the cooling of other articles in a bath of special composition of such cost that it cannot well be run to waste—as oil or brine—the necessity arises of removing the heat surrendered by the material cooled, thus keeping a constant temperature in the dipping tank.

In the case of saw tempering, a large volume of brine is refrigerated and circulated through the dipping vat. The large reserve volume acts as a fly wheel, equalizing fluctuations of temperature arising from varying rates of dipping, the compressor running continuously.—W. C. Kerr, in Cassier's Magazine.

AREAS OF DISEASE.

IT is a common knowledge that diseases have, as a rule, their local habitations, says the London Saturday Review. Some, like tropical animals and plants, live only in the tropics; some, like consumption, are gradually spreading over the whole earth; others, like leprosy and smallpox, are gradually becoming limited in their distribution, and may actually be tending toward extinction. Again, there are regions to which diseases have never reached. On the summits of high mountain ranges and in the circumpolar snowfields the earth and air and water are as barren of the microbes of disease as they are of animal life. Without question, if Nansen and his companion had been exposed to the same hardships and the same unsanitary conditions in these islands, the lowered vitality of their bodies certainly would have been unable to resist the continual bombardment of germs to which we are all subjected. In a country like Britain, thickly populated for many centuries, and with the freest circulation of population, it cannot be doubted that every yard of surface contains the germs of the more common diseases, and the native of some newer land, brought over here, falls a victim to our plague-stricken soil. By generations of a destructive elimination we have become highly resistant to our native diseases, just as the Gold Coast natives are less susceptible than we are to their own local diseases. But we are not fully protected, and cancer and consumption—two of our common scourges—still take a large annual toll. It may be assumed that both are due to micro-organisms, the microbe of consumption being well known, that of cancer being as yet only suspected. Probably no inhabitant of Britain escapes infection by the cancer organism; certainly none escape infection by the microbe of tubercle. Most of us, fortunately, resist the intruders and are unaffected by the disease.

ELECTRICAL NOTES.

The London Electrical Review has this announcement: "Appointment Vacant.—The Morecambe District Council is inviting applications for the post of resident electrical engineer at £175 (about $875) per annum." This is about the wages of an able bodied hod carrier in the United States.

According to a German authority, turbid beer can be clarified by electric light. It is said that if electric lamps are suspended in the fermenting vessels, the yeasty matters are rapidly deposited with the resinous, albuminous, and glutinous substances that are always present. The result is due to the light itself, not to the change in temperature.

During the convention of the Nobles of the Mystic Shrine held in Detroit, June 7 to 10, what was probably the largest trolley party in the world was made up of the visitors. Sixty-seven open cars were used and 3,050 people took in the ride, the route being around the city and ending at the Water Works Park. The cars were gayly decorated with flags, and the conductors and motormen each wore a boutonniere. Not a hitch marred the trip. The affair was managed by Messrs. A. A. Schantz, G. P. A. of the Detroit and Cleveland Steam Navigation Company.

Berlin now possesses an electrically driven underground railway, says the Electrician. A tunnel 380 yards long and 3 ft. 4 in. below the level of the street has been made by the Allgemeine Electricitäts Gesellschaft to connect their two factories in Brunnen Strasse and Acker Strasse. There are two curves of 50 ft. and 80 ft. radius respectively, and a gradient at one end of the line of 1 in 15. The line is of normal gage and single track. The overhead system is used for conveying current to the locomotives. The latter have two motors, and are designed to draw 10 tons.

The American Machinist extracts from a contemporary a gamut of speeds per second, beginning with that of the snail, which is half an inch, and ending with the following: "Electric current on telegraph wires, 7,000 miles; induction current, 11,040 miles; electric current in copper wire armatures, 21,000 miles; light, 180,000 miles; discharge of a Leyden bottle through copper wire 1-16 inch in diameter, 277,100 miles. This last is the greatest rapidity so far measured." These figures might have more weight and more interest if the methods of calculating them or the authorities had also been given.

The flexibility of the electric elevator machine has recently been most strikingly illustrated at one of New York's newest skyscrapers, now being erected in the lower part of the city. Three electric elevators were installed and put in operation while the building was in the very early stages of construction, this being made possible by securing the current from the street lighting system. Rough cages were first operated, serving as hoists for building material and for the various mechanics. Not only has a great deal of time been saved by the early installation of the elevator apparatus, but so efficient has the freight service been that the hod carriers' work has been largely dispensed with, resulting in a saving of money, but, according to the Electrical World, at the same time bringing forth a strong objection from the Hod Carriers' Union.

Koch, in the Elek. Zeit., thinks it will suffice to run ordinary galvanized iron wires around the top and edges of a house, say in the form of about ten wires, each leading into the ground, to protect it from lightning. If telephone or other wires or gas or water pipes enter the house, they should be connected with this system of lightning wires through suitable arresters when necessary. The platinum or gold points he considers unnecessary. Precht has shown that the issuing of electricity from points takes place so slowly that the points cannot respond to the rapid oscillations of the lightning discharge. The wires may be secured directly to the building; as iron rusts when soldered, all soldered joints should be avoided and the wires should be run in continuous lengths into the ground. The earth connections may be made by simply running short pieces of wires into the ground. The cost of such a system for an ordinary house should not exceed $4 to $5.—Elec. World.

A table taken from the annual reports of the railroad commissioners of Massachusetts and New York for nearly all of the street railway properties shows some interesting facts, says the Engineering and Mining Journal. The table gives the number of cars owned, the car mileage per year, and the cost of the electric power per car mile and per passenger. Of the 19 companies operating less than 250,000 car miles, 4 are obtaining power at a cost of less than 2c. per car mile, 6 between 2 and 3c., 5 between 3 and 4c., 1 between 4 and 5c., and 3 at more than 5c.; of the 5 companies operating over 5,000,000 car miles per year, 1 obtains the power for less than 1c. per car mile, 3 between 2 and 1c., and 1 between 2 and 3c.; other similar figures are also given between these limits. The Brooklyn Heights Company has the cheapest power, 0·86c. per car mile, followed by the Binghamton with 0·94c.; the cost of power for the Massachusetts roads includes repairs and depreciation of the station plant, which is not the case for the New York roads.

In a recent article in the American Machinist, Mr. A. M. Lozier, M.E., of the Bullock Electric Manufacturing Company, says: "When electrical transmission stepped to the fore, even the best equipped factories presented a most inconsistent appearance. Their condition might be compared to two strong iron links of a chain held together by a piece of string, for on the one hand their boilers and engines were of the best and most economical types, and on the other hand their tools or printing presses were compact, automatic and highly efficient. But the connecting link, the means of transmitting the power from the engine to the tool, was a weak one, a great source of waste in power and a relic of conservatism. It is astounding that for years, thousands (indeed, one may say millions) of horse power hours have been wasted in the mere friction load of shafting and belting, without any serious consideration of the matter by mill owners and printers. Records of tests made in over 200 representative factories and printing establishments of this country alone show, as an average, that about 50 per cent. of all the power generated by the engines has been wasted in belt or rope transmission of power."

MISCELLANEOUS NOTES.

Johannesburg, according to the latest figures, has now 136,000 inhabitants, 51,000 of whom are whites. There are 16,265 British, 3,335 Russians, 2,263 Germans, 819 Dutch, 442 Frenchmen, 311 Swedes and Norwegians, 200 Italians, and 648 from other non-African countries; the others come from the Orange Free State and the British South African colonies.

The use of liquid fuel is extending in the mines and mills of the Oural region. It has recently been adopted by the Ust-Katoffski Iron Works, and in the iron works at Zlatoust. At the Miniarski Works, in the Szimski district, oil is now used for heating the puddling furnaces, and for all purposes except in the blast furnace, where charcoal is used.

When the Estienne School was opened in Paris last year Le Figaro discovered the last male descendant of the great family of printers, a printer as all his forefathers had been, and regretted that the name must die, as he had a family of daughters only. M. Estienne is now the father of a boy, whom he has named Robert, who will be a printer, too, when he grows up.

Russia's imperial appanages constituting the domain reserved for the support of the younger branches of the imperial family, which was begun by Emperor Paul I, now comprise 21,000,000 acres with a revenue of $10,000,000 a year. The Department of Appanages is the largest land owner, farmer and wine producer in the empire, and is developing timber, sugar and cotton industries on a very large scale. It is distinct from the private possessions of the Romanoffs and from the state or crown demesnes.

The London Chronicle says: "Between March, 1895, and March, 1897, 187,282 men were dispatched to Cuba, 4,827 to Porto Rico, and 26,622 to the Philippines, making a grand total of 218,731. The losses in Cuba from wounds and disease are set down at over 47,000 men, without counting some 16,000 in hospitals. Statistics are not fully returned from the Philippines, but the absence of yellow fever reduces the rate of mortality. The cost of the Cuban war may be roughly estimated at not less than £45,000,000. In the Philippines the expenses mount up to about £400,000 a month. Apart from this burden the nation has had to pay 78,000,000 pesetas in the shape of substitution money for recruits who have shirked the unpleasant duty of serving abroad. Few of the youths sent home from either seat of war will ever regain sound health, as they joined the ranks too early."

Some French lawyers are trying the experiment of giving legal advice free at the Palais de Justice, on the same principle as medicine is dealt out at dispensaries. The idea is a revival of the Bureau of Charitable Jurisprudence, planned by the Constituent Assembly in 1790, and it has been in operation for nearly two years. There are several departments, each managed by a lawyer of ten years' standing, with two younger men as his assistants. The office is open one morning and one afternoon a week. Last year, from January to December, 1,964 persons applied for advice; 1,600 of them merely wanted answers to some legal questions, 17 were lunatics, and 37 well-to-do people were seeking assistance under false pretenses. The lawyers took up, however, 160 delicate and complicated cases and succeeded in settling 61 of them to the satisfaction of their clients; the other 105 were lost after a trial.

"**The value** of the pearls found during 1896 on the coast of the gulf of Lower California," says Handels-Museum, "amounted to $350,000. Besides, there were, however, also exported 5,000 tons of mussel shells, the value of which was estimated at a further $1,250,000. The pearl fishing with appurtenances forms the entire occupation of the natives, and La Paz, the capital for this trade in the peninsula, exists exclusively upon this industry. Until a few years ago only native divers had been employed, and the greatest depth to which they could dive was thirty-five feet. Upon the introduction of the modern diving apparatus a depth of 180 feet was accomplished, and while formerly the best divers could not remain longer than two minutes under water, a modern diver thinks nothing of staying for two hours at a depth of 100 feet, although at a still greater depth the stay is necessarily shortened on account of the enormous volume of water above. The pearl fishing is mostly a matter of good luck, and this is the great charm which attracts the natives, who are almost without exception born gamblers. It is known that not every oyster contains a pearl, and a really valuable one is only now and then met with. Most of the pearls which are found in the waters of Lower California are so-called seed pearls of a very modest value. The divers do not limit themselves to the pearl oysters, but whenever they come across a rare piece of coral or a new kind of mussel they pocket these likewise."

The gold mines of Cañada Honda are the best known of those in the hill range of the province of San Luis, according to a recent article in the Berg- und Hüttenmännische Zeitung. The gold found at Cañada Honda occurs in a comparatively limited area in the valley of that name, and is formed of the detritus of the gold-bearing quartz from the vicinity of the andesite formation, the metal having been washed down as far as Villa Mercedes, leaving the chief deposits of the denuded material near the original site. The workable deposit has a maximum length of 2,200 ft. by 300 ft. in width, and is covered to a depth of about 30 ft. by a barren layer of black earth, followed by a yellow sandy loam. The gold-bearing deposit (Llampos) contains gneiss, crystalline shale, quartzite and andesite, along with a yellow interstitial loam, and has a depth of about 5 ft. A number of depressions, wherein gold has collected, are met with on the surface of the bedrock, and the latter frequently contains gold to a depth of about 1 ft., probably as a result of mechanical agency rather than segregation. The water supply for sluicing is very irregular, there being a scarcity in the winter and frequently a superabundance in the summer season. In winter the chief work is that of washing the deposit exposed by the summer sluicings, and this is effected by three sluices 20 ft. long, 12 in. wide and 8 in. deep, divided into two parts, the lower portion containing the riffles. Four men and a boy are required for working each sluice, and the average daily recovery of gold is ½ to ¾ oz. per sluice.

SELECTED FORMULÆ.

Colors for Polished Brass.—Mr. E. Ebermeyer has just published in the Zeitschrift für der Chemie Indust. formulas for a number of baths, designed to give polished brass various colors. The brass objects are put into boiling solutions composed of different salts, and the intensity of the shade obtained is dependent upon the duration of the immersion. With a solution composed of:

Sulphate of copper	120 grains.
Hydrochlorate of ammonia	30 "
Water	1 quart.

greenish shades are obtained. With the following solution, all the shades of brown from orange brown to cinnamon are obtained:

Chlorate of potash	150 grains.
Sulphate of copper	150 "
Water	1 quart.

The following solution gives the brass first a rosy tint and then colors it violet and blue:

Sulphate of copper	435 grains.
Hyposulphite of soda	300 "
Cream of tartar	150 "
Water	1 pint.

Upon adding to the last solution:

Ammoniacal sulph. of iron	300 grains.
Hyposulphite of soda	300 "

there are obtained, according to the duration of the immersion, yellowish, orange, rosy, then bluish shades. Upon polarizing the ebullition, the blue tint gives way to yellow, and finally to a pretty gray. Silver, under the same circumstances, becomes very beautifully colored. After a long ebullition in the following solution, we obtain a yellow brown shade, and then a remarkable fire red:

Chlorate of potash	75 grains.
Carbonate of nickel	30 "
Salt of nickel	75 "
Water	10 ounces.

The following solution gives a beautiful dark brown color:

Chlorate of potash	75 grains.
Salt of nickel	150 "
Water	10 ounces.

The following gives, in the first place, a red, which passes to blue, then to pale lilac, and finally to white:

Orpiment	75 grains.
Crystallized sal soda	150 "
Water	10 ounces.

The following gives a yellow brown:

Salt of nickel	75 grains.
Sulphate of copper	75 "
Chlorate of potash	75 "
Water	10 ounces.

On mixing the following solutions, sulphur separates and the brass becomes covered with iridescent crystallizations:

1. Cream of tartar	75 grains.
Sulphate of copper	75 "
Water	10 ounces.
2. Hyposulphite of soda	225 grains.
Water	5 ounces.

Upon leaving the brass objects immersed in the following mixture, contained in corked vessels, they at length acquire a very beautiful blue color:

Hepar of sulphur	15 grains.
Ammonia	75 "
Water	4 ounces.

Photographic Hints and Formulas.—

From Liesegang's Photographischer Almanach.—(Amer. Phot. Jl.)

A New Developer for Transparency and Lantern Plates:

Water	60 ounces.
Sulphite of soda (crystals)	60 "
Metol	½ "
Bicarbonate of soda	3 "
Bromide of potassium solution (10 per cent.) a few drops if necessary.	

Dissolve in the given rotation.

Clearness is the first requisite in a good lantern slide, while in a transparency for decorative purposes a slight veiling of the high lights is not objectionable.

Toning and Fixing Baths for Aristo Types:

Plain Bath—

Water	32 ounces.
Pure gold	⅓ gr.

Acetate Soda Bath—

Water	24 ounces.
Acetate of soda, saturated solution	½ "

Gold enough to tone.

Phosphate Soda Bath—

Water	28 ounces.
Phosphate soda	½ "

Gold enough to tone.

Neutralize with bicarbonate of soda or borax. Bath should be as near neutral as possible, or but slightly alkaline. If toning should proceed faster than five minutes, dilute with water. Use strong bath for cold tones and a weak one for warm tones.

Do not overtone; some red should be left in the shadows. When toned put them in running water or—

Salt	4 ounces.
Water	1 gall.

Wash in a couple of changes of fresh water before fixing.

Fixing Bath—

Cold water	1 gall.
Hyposulphite of soda	6½ ounces.

Fix ten to fifteen minutes. Never use the same twice.

Should a harder surface be desired, add, after pictures have been in the bath ten minutes, from 3 to 6 ounces of the following solution:

Alum	1 ounce.
Water	12 "

Fixing bath should be cold.

THE PROPAGATION AND DISTRIBUTION OF FOOD FISHES.

THE report of the United States Commissioner of Fish and Fisheries for the fiscal year ending June 30, 1896, contains some interesting particulars regarding the propagation and distribution of food fishes in the United States. When the present commissioner assumed charge, especial attention was at once directed to increasing the supply of the commercial fishes of the ocean and inland waters, and the propagation and rearing of certain coarser species was discontinued in order to increase the output of more important ones. The principal fish cultural work in hand was the propagation of shad, and the available force was concentrated at the shad hatching stations at Bryan Park, on the Potomac River, and Battery Island, on the Susquehanna River. Work on the New England coast followed, and the usual provisions were made for collecting lobster eggs at Wood's Hole and Gloucester, Mass. The steamer Fish Hawk was also engaged in shad hatching on the Delaware and afterward in collecting lobster and mackerel eggs on the Maine coast, where she was assisted by the schooner Grampus.

SALMON REARING TROUGHS, CRAIG BROOK STATION, ME.

The result as compared with the preceding year was very satisfactory, 148,000,000 shad, 105,000,000 lobster and 31,000,000 tautog eggs being secured. The scarcity of mackerel made it desirable that the government should endeavor to increase the supply of this valuable fish, and steps were taken in April to engage in the propagation of the species at various points on the New England coast. About 24,000,000 eggs were obtained.

The following stations were operated during the year:

Craig Brook, Me.	Fish Ponds, Washington, D. C.
Green Lake, Me.	Wytheville, Va.
St. Johnsbury, Vt.	Put-in Bay, Ohio.
Gloucester, Mass.	Northville, Mich.
Wood's Hole, Mass.	Alpena, Mich.
Cape Vincent, N. Y.	Duluth, Minn.
Delaware River (steamer Fish Hawk).	Quincy, Ill.
Battery Island, Md.	Neosho, Mo.
Bryan Point, Md.	Leadville, Col.
Central Station, Washington, D. C.	Baird, Cal.
	Fort Gaston, Cal.
Clackamas, Ore.	

There have been distributed in suitable public and private waters, by means of the cars and messengers of the commission, 498,488,208 eggs, fry, yearlings and adults of various fishes. The output of some of the more important species, which is markedly in excess of the previous year, is as follows:

Shad	98,481,500
Salmon	10,845,852
Lake trout	8,996,618
Whitefish	189,740,000
Cod	60,212,000
Flatfish	8,172,000
Lobster	97,079,000

Plants were made in all the States and Territories, and eggs of various species were sent to representatives of foreign governments and fish cultural societies in return for similar courtesies received from them as follows:

Quinnat salmon	95,000
Steelhead trout	75,000
Rainbow trout	125,000
Lake trout	50,000
Whitefish	50,000
Total	395,000

FISH REARING PONDS, CRAIG BROOK STATION, ME.

Further experiments have been made in weaving artificial nests in spawning black bass at Wytheville, the fish ponds at Washington and at Put-in Bay. From the results secured at the former station it is believed that artificial nests may be successfully used and the problem of raising this species simplified. In accordance with previous custom, the use of the laboratory at Wood's Hole was granted to representatives of various colleges for biological study, in order that the commission might be benefited by the results of their researches.

The canvass of the fishing industry of the interior waters of the United States begun in the winter of 1895 was resumed and actively pushed during the entire year and is complete. The inquiry did not cover the great lakes, which were canvassed the previous year, but included all those interior States in which the industry was carried on to any great extent. These fisheries are of considerable economical importance, as in 1894 they employed 11,282 persons, representing a total capital invested of $722,328, and yielded to fishermen a product valued at $1,791,145. Inquiries were also prosecuted by local agents at Gloucester and Boston covering a large part of the offshore fishing of New England, which served the purpose of keeping the commission well informed regarding the condition of the great fishing banks of the coasts of New England, Nova Scotia and Newfoundland. At Gloucester there were discharged by American fishing vessels about 76,631,000 pounds of fish and salt fish, valued at $2,205,000; at Boston the quantity of fish landed aggregated 73,808,000 pounds, having a value of $1,346,000. The combined receipts were thus 150,439,000 pounds, valued at $3,551,000. As compared with the previous year there was a net decrease in the quantity of fish landed at Gloucester amounting to about 3,000,000 pounds, the falling off being principally in mackerel, halibut, cusk and hake, while the receipts of cod exceeded those of 1894 by 5,430,000 pounds, and of 1893 by 8,781,000 pounds. The fish brought into Boston in 1895 weighed 13,637,000 pounds less than in the previous year, nearly all of the important species showing a decrease.

In the spring of 1896 the investigations of the salmon streams of the Pacific coast were planned with the view to select suitable sites for hatcheries, and at the close of the fiscal year this work had been begun and was actively carried on. In addition to the regular annual investigation of the fur seal rookeries required of the Fish Commission by act of Congress, arrangements were made for special studies during the summer of 1895 of the natural history of the herds on the Pribilof and Commander Islands for purposes of comparison with their condition in former years with reference to the means necessary for their protection. The investigations are described in detail in the exhaustive report of Mr. Stejneger, published in the bulletin of the commission for 1896.

The fur seal investigations for 1896 provided for a scientific investigation into the present condition of the fur seal herds in the Pribilof, Commander and Kurile Islands. Dr. David S. Jordan was selected to take charge of the party, assisted by Mr. Leonhard Stejneger and Mr. F. A. Lucas, of the United States National Museum, Lieut. Commander J. F. F. Moser, U. S. N., commander of the steamer Albatross, and Mr. C. H. Townsend and Mr. Joseph Murray, special agent of the Treasury Department, and Mr. G. A. Clark, secretary. The Albatross was detailed by the President to convey the party to Bering Sea, and sailed from Seattle, June 24, with the investigators on board. For a brief description of the trip the reader is referred to the report of the commissioner.

Among other work of the commission were studies of the mackerel fisheries, studies into the condition of the oyster fisheries on the coast of Florida, special investigations as to the extermination of migratory fishes in the Indian River, Florida, etc. The exhibit of the commission at the Cotton States and International Exposition, Atlanta, was considered one of the most attractive features of the Exposition, particularly the aquarium. The commission has continued the practice of turning over to the National Museum collections made by its agents and vessels. The commission also issued a number of bulletins and reports.

Having now described the general work of the commission for the fiscal year ending June 30, 1896, we

TROUT PONDS, NORTHVILLE, MICH.

SELECTING AND STRIPPING RIPE TROUT, NORTHVILLE, MICH.

will take up some of the interesting hatcheries which are described in the report of the commission.

From this report it appears that there was a distribution of yearling fish from the Craig Brook (Me.) station, consisting of 151,676 Atlantic salmon, 12,225 landlocked salmon, 27,763 brook trout, 10,000 rainbow trout, and 1,876 Scotch sea trout. The fish were cared for during the summer in the troughs and ponds shown in our illustrations, and were fed on chopped beef, butchers' offal and maggots. The total cost of fish food for the year, including its freight and drayage, was $513.88. The United States Commission and the State of Maine operated conjointly in the collection and maintenance of brood salmon, and in the maintenance and incubation up to shipment of eggs removed to other stations for hatching. To obtain live fish from the weirs about the mouth of the Penobscot, the following method was employed: The fishermen agreeing to furnish live salmon were supplied in advance with large, fine meshed dip nets, lined with flannel to prevent the chafing of the fish; a car was stationed in every neighborhood, and each fisherman whose weirs were so far from the moorings of the car as to forbid their being brought alongside for the direct receipt of captured fish was provided with a large box in which to transport them short distances. As low water approached and before it became low enough to leave the fish stranded on the floor of the box, the salmon were carefully dipped out and placed in the cars. Once a day the collecting steamer made a tour of the district, taking in tow the cars containing salmon and leaving empty ones in their places. The cars were then taken to Dead Brook, where the fish were released in an inclosure of about a third of a mile up and down a sluggish stream, averaging 3 or 4 yards in width and having an extreme depth of about 6 feet. During the season persistent efforts were made to keep the temperature down in the cars by means of ice, and positively favorable results were at last attained by arranging their interiors so that the water, admitted in a greatly reduced volume, should pass through a cooling compartment before reaching the fish. In the application of this method it was necessary to have a separate boat containing a considerable quantity of ice to accompany the fleet. Notwithstanding the fact that every effort was made to protect the salmon from injury in handling, a great many died in a short time from the effects of bruises and chafing. Thirty per cent. may be given as the ordinary ratio of loss out of those liberated in the inclosure.

Egg collections commenced October 26 and closed November 7. The total yield was estimated at 992,000, but a later computation based on careful measurement showed a take of 1,027,353. Of these, 106,653 were lost. The United States received as its portion 602,700 and the State of Maine 318,003. Of those belonging to the station, 329,000 were distributed, and the remainder were reserved for hatching and rearing. Of the 274,158 fry produced from them, 244,405 survived to the close of the year.

In Michigan fish cultural work has been carried on at the Northville station in hatching trout eggs, our illustrations representing the stripping of the fish for eggs and the trout ponds. During the months of July and August the station force was employed as usual in repairing the ponds, improving the grounds and overhauling and repairing the hatching apparatus. The first consignment of lake trout eggs was received on October 27 and the last on December 5, the total collections amounting to 11,122,000, over 3,000,000 in excess of any previous year's take. Owing to the limited capacity of the hatching house it became necessary to ship 5,750,000 of them. Of these eggs, 4,600,000 were shipped in the green stage and 1,150,000 after the eye spots appeared. From those remaining at the station, 1,295,000 fry were hatched and distributed during the months of April and May, plants amounting to 400,000 being made in Lake Huron, 750,000 in Lake Michigan and 100,000 in the Straits of Mackinac. The remaining 45,000 were distributed to private individuals for stocking inland lakes.

For the cultivation of brook trout arrangements were made for the lease of 4 acres of land on a brook flowing into the Au Sable, a field station was established and the collection of fish commenced on August 20. Operations were continued until November 10, during which time 6,453 trout were caught and confined in a pond prepared for them. During the early part of the season the collections were made with rod and line, but after October 1 a seine was used with excellent results, a 20 foot minnow net bringing in at each haul from 5 to 75 trout. The largest catch in any one day was over 600. The first ripe fish were found on October 3, and by the close of the season 390,807 eggs had been secured. From the experience gained this year, there is no doubt that much better results can be secured, and at reduced cost, as it is unnecessary to establish the station before the end of September. A number of experiments were made during the season in transferring eggs before they were eyed from the field stations to Northville. Fourteen shipments of eggs were made, varying in age from 1 to 22 days, and it was found that they could be moved successfully up to and including the eighth day; between the eighth and the eighteenth days the losses were much heavier, in some cases being as high as 50 per cent. The mortality among the wild brook trout taken from the Au Sable early in the summer was very heavy, and only 233,928 eggs were secured from them. From the domesticated stock 46,710 eggs were taken from 78 spawners. Of 667,445 brook trout eggs obtained from all sources during the season, 75,000 were transferred to the United States Fish Commission stations at St. Johnsbury, Cape Vincent and Duluth; 20,000 were furnished to the Minnesota Fish Commission, and 21,000 to applicants in Ohio. From the remaining stock, 200,000 fry were hatched and furnished in March and May to applicants in Michigan, Iowa, Wisconsin and Ohio, for planting in public waters.

LIVING BAROMETERS.

THE spider is a good example of the living barometer. Close observation of the work on its web castle will soon enable one to forecast the weather. When a high wind or a heavy rain threatens, the spider may be seen taking in sail with great energy—that is, shortening the rope filaments that sustain the web structure. If the storm is to be unusually severe or of long duration, the ropes are strengthened as well as shortened, the better to resist the onset of the elements. Not until pleasant weather is again close at hand will the ropes be lengthened as before. On the contrary, when you see the spider running out the slender filaments, it is certain that calm, fine weather has set in, whose duration may be measured by their elongation.

Every twenty-four hours the spider makes some alteration in its web to suit the weather. If these changes are made toward evening, just before sunset, a fine, clear night may be safely counted upon. When the spider sits quiet and dull in the middle of its web, rain is not far off. If it be active, however, and continues so during a shower, then it will be of brief duration, and sunshine will follow. These various indications may be witnessed and studied to the best advantage in the open air. But you need not always go outdoors to watch the spider barometer. There are few houses where the crafty creature does not find an obscure corner wherein to swing its signboard: "Flies taken in and done for here." Watch these places, and when you see the spiders coming out on the walls more freely than usual, you may be sure that rain is near.

There are individuals who would not keep a stock of spiders about their premises for the express purpose of prophesying the weather from their movements, and the enmity felt by the good housemaid for this particular species of animal is notorious. Those individuals can study the movements of their own domestic animals. Cats and dogs are given to scratching and other uneasy movements on the approach of rainy weather, and their fur looks less bright and glossy. Horses and cattle stretch their necks and sniff the air. Sheep become frolicsome or turn their backs to the wind, and quarrel frequently. Goats bleat incessantly, and leave the hilltops for more sheltered spots. Pigs run uneasily about, carrying straw to the sty, and no longer wallow in the mud and mire. Fowls huddle together in the farmyard with drooping wings, and the air is filled with the clamorous cackle of geese and ducks. Those who live in the country and spend much time in the open air have the advantage of observing the movements of wild animals, and of feeling keenly in their own persons the operations of the changing atmospherical conditions. Moles become more active in digging; stoats and weasels become unusually restless and uneasy; and the hedgehog fortifies his cave against the coming storm with an unfailing provision which has earned for him a most enviable reputation as a weather prophet.

Wild birds make still better objects of observation, because in the "large air" their actions are easily noted. Crows and swallows remain near home when a tempest is brewing; seagulls no longer venture out to sea, but hover over the fields or fly inland when wind and rain are near; swallows fly low and skim the water; and the robin broods melancholy in the bush, or seeks the shelter of a neighboring roof. These are only a few of the many creatures of the fields and the air which enable a man who has eyes to see to forecast the weather during the next few hours. The explanation of all this is to be found in the exceeding sensitiveness of most animals, especially those which are more or less wild, to atmospherical conditions. They are all constantly making forecasts after their own manner, and, as we have hinted, they are far more trustworthy than any devices of man toward this end.

Several ingenious attempts have recently been made to turn this unfailing instinct to some commercial use. A number of very unique living barometers have been put upon the market. The cheapest, and the one which will probably become the most popular, is the frog barometer. A small green frog is found in Germany, which always comes out of the water when cold or wet weather is approaching. These frogs are caught and kept in glass jars furnished with a tiny ladder and half filled with water. The frog weather prophet sits high and dry on the top of his ladder for several hours before a storm, and climbs down to the bottom when the weather is to be fair and clear. Other remarkable weather prophets are leeches, and we have heard of an old meteorologist who adjusted his barometer in such a way that the leeches would ring a little bell whenever a storm was approaching, and would remain silent when the weather was fair or setting fair. These creatures will also indicate the weather in the same way as the green frog referred to. If kept in a jar filled with water, they will climb up the sides when it is about to rain, and gather round the top.—London Standard.

BIVALVES AND TOOTH SHELLS.

THE following are excerpts from a lecture delivered at the Academy of Natural Sciences, of Philadelphia, by Prof. Pilsbry, of that institution.

Among the lamellibranchiata the principal peculiarity is the gills, formed of two plates going down each side of the body. They may be known from all other mollusks by the bivalve shell in which they are closed. They have no eyes on the head and no tentacles. They lack the radula, or hard organ, for grinding the food; while all the other mollusks have this. Lacking this hard part for dividing the food, they live chiefly on infusoria, desmids and diatoms. The sole organ of protection for the bivalves is the shell, composed of two parts, usually fitting more or less exactly when closed. Some of the fishes have jaws strong enough to crush bivalves and swallow the whole animal and digest the contents. Some birds will carry them up into the air and let the shells drop and break, and then eat the contents.

Some mollusca are eaten by star fish; but the method by which the latter gets at them is not known. A number of bivalves are infested by a little crab called oyster crab. It lives in the mantle cavity of the bivalve and obtains its nutriment from the water which is brought in by the bivalve. It is not in any sense truly parasitic on the bivalve.

Aristotle first gave to the oyster crab its scientific name—pinnotheres, because found in the bivalve pinna, abounding in Greek waters.

Most oysters live partially or wholly buried in the mud, communicating with the surface by means of a very long siphon. The head end is always downward; so that they live really standing on the head. The body walls and the gills in the bivalve divide the body into two parts: First, the lower part, called the lower branchial cavity, and the upper cavity above the gills. There is absolutely no connection between these two cavities of the bivalve, except through the gills and through the digestive tract, so that water will not freely pass from one to the other, but has to be filtered through the gills. The gills not only cause a current of water to flow all the time, but also aerate the blood. The same water supplies the food, so that in the bivalve there are always two totally distinct openings, although sometimes there is no organic dividing line between them, the division being made simply by proximity of the mantle at that place; through the lower the water is passing inward; through the upper, it is always passing outward.

The two valves of the bivalve are held together by a hinge along the upper margin, which is more or less of the consistence of cartilage in the fresh specimen, and which, being very elastic and contractile, tends always to keep the valves gaping open. This tendency to keep always open is counteracted by two strong muscles situated at the end of the body, and which, by their contraction, close the valves.

The nervous system of the bivalve is a very simple modification of that of all the other mollusca. There is a ring around the orifice, composed of several ganglia, of which the cerebral is the principal one. The siphons are formed in the simplest manner, by juxtaposition of the two mantles.

In some bivalves the siphon is extremely long, especially in a Pacific coast species—over a yard in length—and it takes the greater part of an afternoon to dig one out, though very edible when secured.

In the astragali the united mantle margins and the siphon have become calcified by the deposit of lime in their surface, and the result is a calcareous tube, having very little resemblance to an ordinary bivalve. At the foot end of the astragalus there are a great many perforations.

Another form in which the siphon is greatly developed is teredo, or the ship worm. Some wood was submerged four years, and was nearly eaten out in that time.

The ship worm first enters by a minute hole, scarcely larger than a pin would make. The eggs, which float in the water, are caught and stuck against the pile, and the animal hatches in this minute hole, and thus perforates the wood, generally boring parallel to the grain, and avoiding running into one another's holes, and two holes seldom being found confluent. Their ravages are found sufficient to destroy most woodwork put into the water in temperate or tropical climates.

Mussels deeply buried practically never remove after once getting themselves into their holes.

The pholads bore into hard rock. The food of the pholas is tough and hard, and by rubbing against the stone and clay and sand, they gradually wear away a hole for themselves.

The pearl oyster has only one muscle. This arises by reason of the decrease of the interior muscle, which is nearest the mouth, and the consequent increase of the other muscle in order to fulfill the functions of both of them.

In the oyster there are a number of other conditions not found in ordinary bivalves. The two valves are rarely equal. This is the result of the fact that the oyster usually lies on one side or stands upright, and is attached by one valve to another oyster or rock or to branches of trees in the water.

Most people who eat oysters do not realize that the rather shapeless mass contains gills, muscles, nerves, digestive and reproductive organs—all the apparatus of a highly complicated living thing. Bivalves are such helpless things that we hardly ever give them credit for being alive, much less for having organs.

It may be interesting to see what the organization of an oyster is. On removing the top valve and the mantle, we find that they have two gills, lying on each side of the body, just within the muscle, and upon removing these, we find in the center the large adductor muscle and the labial palpi (comparatively very large in the oyster) and the digestive system, very much on the plan of the ordinary mussel. The dark portion is the liver. In all mollusca the liver is very highly developed. The mantle is free all the way round in the oyster, not united, and they are entirely without siphons, because the oysters, not boring at all, have no need of any siphons to convey the water to them. Oysters occur on nearly all coasts, and every part of the world has its own particular species.

The European oysters are much smaller than our Chesapeake Bay oysters. California oysters have a copper taste. In South Australia the oysters are as large as a dinner plate. On the coast of Japan I have seen oysters nearly two feet long. From the Loo Choo Islands I have had oysters sent me nine inches long and seven inches wide. One oyster would be enough for a small family.

The good parts of the oyster are largely due to the absence of the foot, which makes the clam so tough and hard; but the oyster, on account of all its life being attached, has the foot rudimentary. In fact, it is reduced to almost nothing, so that the greater part of the animal is simply the soft organs—the only hard organ being the adductor muscle. The foot is always most developed in the bivalves, which use it for digging—such as the razor shell and the river mussels; but in forms living all their lives attached, the foot is reduced to a mere rudiment.

The two parts of a bivalve are, of course, called the valves, being connected by a hinge above. In some forms the mechanism for opening these is an external hinge, as in the ordinary river mussels; but in others, as the beach clam, there is no external conventional hinge, the mechanism being an internal cushion or cartilage.

The accurate closing of the valves is insured by what are called teeth along the margin of the shell. These are interlocking processes which prevent side play and cause the valves, when closed, to close accurately one upon the other. The teeth of bivalves are of several kinds. The most primitive kind are a row of comb-like teeth along its great hinge line.

The interior of the shell also shows a good many characteristic marks. The mantle is the fleshy organ which lines the shell.

TOOTH SHELLS.

The scaphopod shell is simply a tooth, tapering to a

point at one end. The foot is a long organ, somewhat like the foot of bivalves, but very slender. They have a distinct head, in which the mouth is in the center of a row of little lobes or leaflets at the end of the head, and the whole surrounded by very numerous tentacles, with which it catches its prey. These tentacles are knobbed at the summit, but flexible. There is no gill, the blood being aerated simply by the water in its relation to the skin. The whole, general skin serves as a gill. There are no eyes; the ears are present, and the heart pumps arterial blood only. The head and feet are crowded close together; but this is also the case in bivalves.

A scaphopod always reminds me of a man who had a great tie around his body and was pulled by this great tie into a barrel, because of the very close relation of the head and feet. There is no very distinct stomach, and there is a very large and complex liver. The sexes are separate, that is, in two separate individuals, instead of (as in many bivalves) both sexes being united in one individual. The scaphopods live in water from one to two fathoms deep, down to the greatest depths which have been explored so far, some having been brought up from water 3,000 fathoms deep (about four miles). They live in muddy bottoms as a rule, immersed for nearly their whole length in the mud, only leaving the small end sticking upward; and in Oregon and in Washington the aborigines of that coast use the shells of scaphopods for money. The Indians make a sort of rake, by sticking pegs in a board and fastening that on the end of a long stick, and then go along in a canoe and push the stick down in the mud, and these small pegs would every once in awhile catch in the small end of a dentalium and bring them up; and in that way they would capture a large number and use them for money, before banks and the white man's currency replaced them.

The shells of the scaphopod range from two to three inches long to perhaps 1-16 inch for the smallest sort. There are only two principal genera of them, which is also a contrast to the other groups of mollusks. The principal genus is dentalium, in which the shell gradually tapers from a small end to a large end; and the other genus is cadulus, in which the shell is swollen in the middle, and, while tapering most toward the upper end, tapers also toward the mouth end. In cadulus there is also a modification of the foot; it is longer than in dentalium and ends with a disk with crenelated border.

When the animal is digging, it elongates this disk and makes it very much slenderer and more pointed and sticks it down into the mud; and then it inflates it by forcing water down through it, and, by the contraction of the foot, pulls the whole shell downward. That is the general mode of digging of all the dentalia. If one is put on the surface, it inserts the foot and enlarges the end and pulls on the muscle. The muscle is inserted at the foot and is fastened on at the smaller end, so that by its contraction the foot and all the soft parts are retracted into the shell, so that in the two classes of mollusks we have considered this afternoon—the lamellibranchiata, or bivalves, and the scaphopods—we can always distinguish them by the shells—by the fact that in the lamellibranchiata a two-valve shell is always present and in the scaphopods there is a two-valve shell open at both ends.

A NEW CLASSIFICATION OF STELLAR SPECTRA.*

MANY of the recent advances in our knowledge of the constitution of the stars are traceable to Prof. Pickering's revival of Fraunhofer's mode of investigating stellar spectra. The endowment of this research by Mrs. Draper as a memorial to her husband, Dr. Henry Draper, has enabled Prof. Pickering to apply this method in two principal directions. First, a series of photographs was taken on a small scale to indicate the chief characteristics of the spectra of a very great number of stars; second, in the case of the brighter stars, another series was taken with greater dispersion with the view of facilitating an inquiry into the more minute features of each type of spectrum. The results of the first investigation are comprised in the well known "Draper Catalogue," giving particulars of the spectra of over 10,000 stars (Nature, vol. xlv, p. 427), and the research has now been advanced another stage by the publication of the results obtained along the second line of inquiry.

The new series of photographs has been taken with one to four objective prisms of 15° each in conjunction with the 11 inch Draper telescope of 153 inches focal length.

When four prisms were employed, the spectra were 8 centimeters long from Hδ to Hϵ, and with one prism 2 centimeters. Since only the brighter spectra could be photographed with the highest dispersion, some of the more typical of these were also photographed with one and two prisms in order to give a proper term of comparison with the spectra of the fainter stars. In all, 4,800 photographs of the spectra of 681 of the brighter stars north of declination —30° are included in the present discussion. By the use of plates stained with erythrosin the spectra of several stars have been photographed in the green and yellow.

As in all previous work involving considerable numbers of stellar spectra, it has been found that the spectra can be classified in large groups, between which there are intermediate varieties. "Large numbers of almost identical spectra are found, even when several hundred lines appear in each." The description of the spectra accordingly takes the form of an account of typical stars in the scheme of classification adopted, accompanied by tables of the lines which characterize the larger groups. No attempt has apparently been made to assign chemical origins to the various lines, so that the endeavor to arrive at a natural and satisfactory system of classification may be regarded as the most important part of the discussion.

The classification of stars has another object besides that of the mere grouping together of those which have similar spectra. It is generally believed that the various types of spectra represent different stages of stellar evolution, but there are divergences of opinion as to the exact order in which the various types should follow each other. Dr. Vogel still holds, with some slight modifications, to the classification which he suggested in 1874, and believes that all the stars can be arranged along a descending line of temperature. Sir Norman Lockyer, who has adopted the same method of work as Prof. Pickering, and has also obtained large scale photographs of stellar spectra, finds evidence that there are some stars which are getting hotter, while others are becoming cooler, so that the two series of spectra can be recognized.

For the Draper Catalogue a somewhat arbitrary and provisional classification was adopted, but this has not been found sufficient to meet the requirements of the more detailed results which are now available.

Among the stars with line spectra, as previous researches have shown, there are a few sets of lines which occur with various relative intensities in different stars, each set in some degree varying bodily, and the new classification is based chiefly upon the distribution of these sets. As will appear later, the classification adopted by Miss Maury also takes account of the appearance as well as of the positions of spectral lines, and every care has been taken to eliminate instrumental sources of error.

Four distinct sets of lines are distinguished. The first includes the lines of hydrogen and calcium, and the remainder are thus described:

"Another class of lines frequently mentioned comprises those which are characteristic of the solar spectrum, excluding the lines of hydrogen and calcium. They are called 'solar' lines, except when referring to lines not contained in the solar spectrum, in which case they are called metallic lines.

"A third class of lines includes those known as 'Orion lines,' from the fact that they are conspicuous in the spectra of many stars belonging to the constellation Orion. . . .

"Certain stars, such as α Cygni and δ Canis Majoris, have spectra in which the majority of the lines, though probably identical in position with lines belonging to the solar spectrum, differ greatly in intensity, while others apparently are not represented in the solar spectrum. The characteristic lines of such stars should perhaps be regarded as forming a class distinct from those already described."

Bearing in mind these different classes of lines, the new system of classification can readily be understood. Excluding "composite" spectra and bright line stars, "the stars were arranged in an apparently progressive series, which in the present case was made to include twenty-two groups. . . . But it also appeared that a single series was inadequate to represent the peculiarities which presented themselves in certain cases, and that it would be more satisfactory to assume the existence of collateral series."

Three lines of progression are recognized in the earlier stages, and are called "divisions." Stars of division a are characterized by lines having the appearance with which we are familiar in the solar spectrum; that is, they are fine and sharp, if hydrogen and calcium be excluded. Those of division b are uniformly hazy as in α Aquilæ, but otherwise present no notable differences in relative intensity from corresponding lines which are sharp in division a, so that "there appears to be no decided difference in the constitution of the stars belonging respectively to the two divisions." In division c the hydrogen lines are narrow and sharp and less intense than in the other divisions, while several lines, some of which do not correspond with solar lines, are of unusually great intensity; these are especially marked in α Cygni.

Groups and divisions alike proceed by very gradual stages in some parts of the series, and it has frequently been found difficult to assign some of the stars their proper places.

In consequence of the adoption of the term "group," which has been in use for the last ten years in connection with Sir Norman Lockyer's classification, some confusion may possibly occur, as similarly numbered groups include different stars. To avoid ambiguity, it will therefore be necessary, in the case of the first seven groups at least, to specify the system of classification in question. In what follows, the Draper groups will be distinguished by the addition of the letter D to the number where necessary.

Of the twenty-two groups, the first five include stars in which the Orion lines are especially marked; the sixth contains stars intermediate between this type and the first type of Secchi, to which belong the stars in the seventh to the eleventh groups inclusive. The twelfth group is intermediate between Secchi's first and second types, and the stars included in groups thirteen to sixteen are of Secchi's second type. Groups seventeen to twenty inclusive correspond to Secchi's third type, and the groups twenty-one and twenty-two to the fourth and fifth types respectively. Besides these, two unnumbered groups are recognized, one containing composite spectra, apparently resolvable into two or more, and the other including stars of the Orion type which also show bright lines. Nebulæ find no place among the numbered groups, but reference is made to a former paper (Ast. Nach., vol. 127, p. 1), in which it was suggested that the Wolf Rayet stars probably form a connecting link between the spectra of nebulæ and those of the Orion type.

It is not possible within the limits of this notice to indicate the full details of the twenty-two groups with their subdivisions, but the general course of development which is suggested may be briefly stated.

In group I D, of which ϵ Orionis is a type, the hydrogen lines are comparatively faint, while the Orion lines are strong, and "solar" lines are absent. Passing to Secchi's first type, through groups II D to V D, the Orion lines become fainter and less numerous until in the spectrum of Sirius (group VII D) all but two or three are wanting. Meanwhile solar lines have become numerous, and the hydrogen lines reach their maximum intensity. The transition to succeeding groups is very gradual, hydrogen lines thinning out and solar lines becoming stronger. Arriving at stars like Capella and the sun (group XIV D), the intensity of the hydrogen lines is little more than a tenth of that shown in Sirius, and they afterward continue to decrease, but less rapidly, down to the third type stars (groups XVII D to XX D), where they are inconspicuous. In the third type stars banded absorption appears, and becomes more marked in each succeeding group, while the majority of the lines fade out in the later groups. An important feature of the series is the manifestation of extensive absorption in the later groups of second type stars and in those of the third type.

For the present, the series is regarded as ending with the spectra of the third type, stars following the twentieth group not being considered as having a place in the series exhibiting the gradual development of stellar spectra.

Spectra of division c are not found after the thirteenth group, and those of division b disappear still earlier, "so that the series tends to become more uniform as it progresses."

In connection with the new classification, it is remarked (p. 11) that "while it will be generally admitted that the series represents successive stages in stellar evolution, it may still be doubted whether the arrangement beginning with the Orion type, and here adopted, is in fact the natural order. It is strongly indicated, however, by the gradual falling off of the more refrangible rays in the successive groups, by the corresponding increase in the less refrangible rays, and by the occurrence of marked absorption at the close of the series. The comparative simplicity of the Orion spectra and the increasing complexity shown throughout the series lends additional weight to the argument. Finally, the prevalence of the Orion type in great nebulous regions, as in Orion and the Pleiades, indicates very emphatically that stars of this type are in an early stage of development."

It will be seen that the supposed evolutionary series has been arrived at without reference to temperature considerations. Nevertheless, a gradual reduction of temperature as the series progresses is suggested by the diminishing intensity of the more refrangible rays, so that, in the main series at least, the order is in all probability one of gradually reducing temperature.

As already remarked, the stars of Secchi's fourth type have been omitted from the supposed evolutionary series of spectra, for the reason that the few lines photographed "have not yet been identified with those of other classes of stars, owing to the total dissimilarity of the spectra." This dissimilarity is stated to extend to the yellow part of the spectrum, and is difficult to comprehend in the light of the more recent results obtained by Dr. McClean, who has shown that the spectrum of 152 Schj contains many lines which are apparently identical with lines in the spectrum of α Orionis (Monthly Notices, vol. lvii, p. 8). The existence of carbon absorption in the solar spectrum, however, is of itself, as Lockyer long ago insisted, a sufficient connecting link between stars resembling the sun and stars in which carbon absorption is predominant. A classification which excludes these stars from the evolutionary series cannot, therefore, be regarded as final.

It is perhaps unfortunate that the new classification was adopted prior to the discovery of terrestrial sources of helium. Many of the "Orion" lines are now known to be due to this gas, but not all of them, so that these lines may be subdivided into groups. In the preface to the volume Prof. Pickering remarks: "As the investigations were made several years ago, they could not take account of the recent discoveries respecting the spectrum of helium, which, if known at the time, might have had an important influence upon some of the conclusions. Such modifications could not now be introduced without practically rewriting the treatise, which is therefore published without change. A discussion of the relation of the spectra of stars of the Orion type to that of helium has, however, been made, and is contained in the supplementary notes."

The question of classification, however, is not the sole feature of interest possessed by the spectroscopic work at Harvard. Besides this, there are several tables which give the wave lengths of the lines depicted on the photographs, a general catalogue of the spectra, and copious remarks on the spectra of individual stars. In the case of the composite spectra it has been noted that in all but one, o Andromedæ, the spectrum of the earlier type was the fainter. The peculiarities of the spectrum of γ Cassiopeiæ, already recorded by Lockyer (Nature, vol. li, p. 425), have been fully confirmed, and the additional fact observed that the entire region of the spectrum from λ 4154·7 to 3957·1 appears brighter than the rest of the spectrum, although the brightening is not homogeneous. The possible importance of this feature is suggested by its occurrence also in stars of the first two groups of the new classification.

The complex phenomena in the variable spectrum of β Lyræ are fully detailed, and the composite character of the dark line spectrum detected at Kensington by Sir Norman Lockyer receives independent confirmation. It is concluded that "the bright bands accompany a spectrum approximately of group IV D (e. g. γ Orionis), which oscillates periodically over one of group VII D, division c" (e. g. η Leonis), a result which agrees very closely with Lockyer's conclusion that the two dark line stars were not very unlike γ Orionis and β Orionis. It is pointed out that the supposition of a system of three bodies explains most of the spectral phenomena of β Lyræ, but not all of them, and the rapid and complex transformations require to be continuously followed before a complete explanation can be given.

While fully aware of the difficulty attending the satisfactory reproduction of stellar spectra, we think the value of the volume would have been greatly increased by some attempt to give copies of photographs of as many as possible of the typical stars. Without such reproductions the classification can scarcely be adopted by others taking up the work unless photographs of all the typical stars are first obtained. In spite of this drawback, the volume is a magnificent contribution to celestial spectroscopy, and will be of the greatest value to those pursuing similar investigations. Prof. Pickering and his assistants are to be congratulated upon the excellence of this additional contribution to the Henry Draper Memorial.—A. Fowler, in Nature.

Paris' monumental Alexander III bridge to connect the esplanade of the Invalides with the Champs Elysees, is causing trouble. It was to be 180 ft. wide, but the engineers' estimates were so much below the actual cost that it will be only possible to build a bridge of half the width with much cheaper material for the money voted.

* Spectra of bright stars, photographed with the 11 inch Draper telescope as a part of the Henry Draper Memorial, and discussed by Antonia C. Maury, under the direction of Edward C. Pickering. (Annals of Harvard College Observatory, vol. xxviii, part 1, 1897.)

THE PIRATES OF MOROCCO.

NOT a single year passes that Morocco does not attract the attention of the civilized world in a disagreeable manner. The entire cost of Morocco is feared and avoided by ships of all nations, for piracy of the most unrestrained and boldest kind is always practiced there, one of the most dangerous points being Cape Tres Forcas, which extends far out into the sea. What difference does it make if Spain has garrisoned Melilla? Spanish power is effective only within gunshot. In the great bay that extends from here to Atalaya many sailing vessels have disappeared without leaving a trace. It is always the same story: a vessel coming from the West at night went too near the shore and was detained there by one of the frequent calms. In such a case only an opportune breeze could help it, unless a Spanish or English gunboat happened to pass that way. As soon as a helpless boat is discovered by the Riffians who are always on the lookout, smoke signals are lighted on the high points of the coast to call the bands together, and then the ship can only await an attack by the bold pirates armed to the teeth who row out to it in their boats.

The following incident shows that the robbers do not always have an easy time. In the latter part of the seventies the Marseilles brig Jeanette went to Senegal with forty-two Italian workmen. They were weather-beaten fellows, mostly Calabrians, and each one was armed with a revolver and a knife and they carried their tools, which were flat axes with long handles. There was also a good little cannon on board. Adverse winds forced the captain out of his course, and one morning he found himself under the rocky coast south of Mogador. About ten o'clock the first pirate boats were close to his vessel. They were received by a hail of revolver balls and the cannon did good work. Two of the boats were sunken and the brown mob tried to get out of the dangerous neighborhood of the brig by swimming. The long handled axes proved very useful when an attempt was made to board the vessel. The whole battle did not last ten minutes, for the boats hurried away to land, followed by the shots of the victors, who were soon after helped away by a favorable northeast wind.—Illustrirte Zeitung.


SMOKE SIGNALS OF RIFFIANS ON THE COAST OF MOROCCO.

DRAWN BY RICHARD FUCHS.

MODERN LOSSES IN BATTLE.

COMPARE the slaughter in Napoleon's campaigns with the worst within living memory—with Gettysburg and Antietam, in the American civil war; with Königgrätz, in the Austro-Prussian war; with Sedan and Metz, in the Franco-German war, says a writer in Chambers's Journal. At Jena, in 1806, the Prussian loss was 21,000 out of a total of 105,000, and the French 19,000 out of a total of 90,000—that is to say, 40,000 casualties out of 195,000 engaged, or, roughly speaking, one in five. At Eylau, in 1807, the Russians lost 25,000 men out of 73,000; the French 30,000 out of 85,000—that is, for both sides, the appalling proportion of one to three! At Wagram, in 1809, the Austrian loss was 25,000 out of 100,000; the French 23,000 out of the same number. At Aspern, where Napoleon suffered his first defeat on May 21 and 22, 1809, the carnage was still greater, for the French lost 35,000 men out of 70,000—one-half their number—and the Austrians 20,000 out of 80,000. But even this awful butchery pales before that of Borodino in the Moscow campaign, for on that field the French left 50,000 dead and wounded out of 132,000 engaged, and the Russians 45,000 out of the same number—95,000 men slain or mutilated out of 264,000!

Now, the only battle in the latter half of the nineteenth century which can compare with Borodino in slaughter is that of Königgrätz, or Sadowa, in 1866, which ended the Austro-Prussian war. Out of 400,000 men engaged, 50,000 were killed or wounded—40,000 Austrians and 10,000 Prussians—one in eight only, as against one in three.

The most sanguinary battle in the American civil war was that of Antietam Creek, fought between McClellan and Lee on September 17, 1862, when, after repeated repulses, the Federals compelled the Confederates to retreat. Out of 100,000 men engaged, 26,460 were left on the field—the Federal loss being 12,460, and that of the Confederates 14,000; and that, remember, was before the era of breechloaders. At Gettysburg the combined losses were 43,000; but the number of men engaged was nearly double, and the proportion, therefore, was not quite so great as at Antietam.

Take, again, Leipzig and Waterloo, and contrast them with Sadowa and Sedan. At Leipzig the French lost 60,000 men out of 160,000, and the Allies 42,000 out of 288,000—102,000 out of a total of 348,000—more than double the ratio of Sadowa. Then at Waterloo the losses of the Allies amounted to 22,976 out of 83,000, and those of the French to upward of 30,000 out of 73,000—in other words, one man out of every three that fought that day was either killed or wounded. Now, at Sedan, under the awful crushing fire of the German guns, the French lost 30,000 out of 150,000 before they surrendered—a far smaller proportion than at Waterloo; while the Germans stated their losses at 3,022 killed and 5,909 wounded, out of the 250,000 brought into action.

These facts and figures seem to us to prove conclusively that war is no longer so murderous as it was. The alteration in tactics and in the formation of troops attacking has counteracted the superior precision and range of modern firearms. The shell, though its moral effect is greater, is not so destructive as the round shot, grape and canister of the old days playing upon troops advancing in line or column. The magazine rifle, incalculably superior in accuracy and penetrating power to the old Brown Bess, is not so deadly in its effect; for when it fails to kill outright, the wounds it inflicts with its tiny projectile are not nearly so ugly and crippling as those of the old spherical bullet, which smashed where the other glances off.

THE RELATION OF HYPNOTISM TO THE SUBCONSCIOUS MIND.*

By GEORGE E. BILL, M.D., Harrisburg, Pa.

THE subject which it has been thought fit to discuss with the society at this time is one believed to be of very great import and latitude in the art and practice of medicine. So evident must this be to the thoughtful mind, that it would seem impossible, in the time allotted by the custom of the society, to more than enter the boundary of a field of inquiry the meaning and possibilities of which are so vast. Therefore only one phase of the topic will be emphasized—the subconscious or subjective mind.

The bald definition of the word hypnotism, strictly speaking, is the artificial production of sleep; but the tendency of the present is to extend its meaning, in order to include the various phenomena to be noted under the head of mesmeric, magnetic or fluidic hypnotism, physical hypnotism, and suggestive hypnotism. These three forms may be used singly or together in medicine.

While there have been, in every epoch and in all climes, students and investigators, renowned or otherwise, in this broad domain, there is no basic fact observable in all their research which they themselves understood as capable of inherently formulating a working law explanatory of hypnotic phenomena. Mesmer formulated his theory of animal magnetism, but his methods savored of charlatanism to the uninitiated, and, apart from his manipulations and their undoubtedly curative effect on disease, no scientific cause could be discovered at that time, except as ascribable to the imagination of the patient.

Braid, by his discovery that fixity of vision or fixed attention induced hypnosis, recalled the desire of the medical world to a further investigation of a tabooed study; but because the various phenomena therein unfolded could be attributable to physicism it was thought that a final quietus had been put upon the claims of Mesmer. As you know, in more modern times, however, there have arisen two schools of hypnotic research—Nancy and Paris. Both adopted somewhat the method of Braid, but to the school of Nancy belongs the honor of first placing the study upon a proper basis in science, and of formulating a law. The school of Paris holds that the various phenomena of hypnotism pertain to neurosis, a conclusion obviously not always correct. Nancy, on the other hand, asserts that hypnotic phenomena pervade the most absolutely healthy organism. It is questionable if both together have not evolved laws of equal value out of the chaos obtaining in the times previous to their origin. Nancy has formulated the great law of suggestion, which underlies all actual scientific progress in the domain of hypnotism. On the other hand, the great name of Charcot and his gigantic labor have caused to be brought prominently before professional recognition and study that almost unknown realm, the subconscious mind. It is impossible to clearly perceive that the one is of value without the other—viz., the law of suggestion and the subconscious mind. Both are of profound and equal importance, neither can do without the other, and both work together in both subject and operator, controlled or controller, in every hypnotic séance. Various are the means and methods employed to induce a condition of hypnosis. The loud command, the flashing mirror, the bright light, the forward or upward fixity of vision, the magnetic pass, the revolving chair, all have for their aim the subduing of the conscious objective mind, which cannot per se be hypnotically influenced. It is to this last fact that it is particularly desirable to call your attention, viz., that it is what Thomson Jay

* Read before the Dauphin, Pa., County Medical Society, January —, 1897.—From the New York Medical Journal.

A MERCHANT VESSEL ATTACKED BY RIFFIANS OFF THE COAST OF MOROCCO.—DRAWN BY RICHARD FUCHS.

Hudson so aptly denominates as the subjective mind, existent in all sentient life, that is always influenced by the law of suggestion, either orally or mentally expressed, and not the objective mind, for the latter cannot be so influenced against its reason. This law of suggestion, so happily discovered, applicable alone to the subconscious mind, and a third fact in hypnotism, *telepathy*, to which your attention will again be called, explain as nothing else can the various phenomena of hypnotism. They are of fundamental value and pervade the whole question of hypnotism in medicine, and are of transcendent therapeutic import. As far back as the student can penetrate, a duality of mind has been recognized by the profoundest thinkers, and it would appear that modern research only emphasizes this ancient division as true.

The more commonly accepted division is known as the conscious and subconscious mind, but the most apt and most natural and distinctive phraseology, since it better accords with various symptomata of disease, would seem to be that of Hudson, who adopts as terms of distinction the words subjective and objective. He says, in effect, that the objective mind exercises its functions with its objective surroundings through the media of the special senses, and is that part of the mind necessarily connecting man in his entirety with physicism. By reason of its objective education it enables him to exist within his physical environment and its "highest function is that of reasoning." *

"The subjective mind takes cognizance of its environment by means independent of the physical senses. It perceives by intuition. It is the seat of the emotions and the storehouse of memory. It performs its highest functions when the objective senses are in abeyance. In a word, it is that intelligence which makes itself manifest in a hypnotic subject when he is in a state of somnambulism." †

The distinction herein expressed offers to your reader the best explanation, in its applicability, of the universal value of the law of suggestion, in the various phenomena of disease. It would seem on profound thought that the subjective mind does, as Hudson asserts, "preside over the emotions and functions of the body," and as a corollary it may be added that it also controls the action of the sympathetic, if measurably so in the male, still more so in the female, by reason of her greater richness of sympathetic endowment; for in the deepest hypnotic stages the female observes through the solar plexus, the male through the pineal gland and medulla oblongata.

Now, it is most instructive and most curious to observe that no physician and no patient are thrown into each other's contact in any walk of life, lay or medical, without these bases of hypnotism unconsciously becoming apparent, and it is this fact, of such wide significance, of such universal bearing, from the beginning of medical times until now, that the medical profession as a whole has either ignored, has been unconscious of, or has even unconsciously used in therapeusis. It is even illustrated in the placebo. That this is eminently true springs from the fact that the physician's attitude, his entire status, public or private, is one of command, of direction, of leadership, while that of the patient is one of submission to an ill, an attitude born of fear, which is an inductive hypnotic element of itself, a condition of entreaty that he be better, of hope that he be aided, of faith that he be cured. This obvious and suggestive fact in the above status being of such pregnant importance, how can we not observe then in this very condition of society a therapeutic buckler capable of fending the arrows of disease, functional or organic? Why, then, should the physician shoot the envenomed shaft of ridicule against so potent a shield from disease as hypnosis? If hypnotism has been synonymous with quackery, it should be no longer so regarded by the medical profession.

* T. J. Hudson. The Law of Psychic Phenomena.

† Id. opus, page 29.

It has been found that there are in the main two general divisions of hypnotic effort. One makes use of the means above noted for its induction, and always presupposes a concentration on the part of the subject and operator, and demands the entire recognition of the operator by the patient and oblivion to all other externals, and is the form of hypnosis in most general use. This form demands also the conscious surrender of the subject to the objective will of the operator, and is objectionable therapeutically, because its practice leads to vacillating volition, except in selected cases, embraced under sexual perversion, alcoholism, morphinism, and criminal impulse.

There is another form, however, which can be more widely employed with benefit to the majority of patients with no harmful results to their objective will power, and with increasing aid to the physician in controlling the symptomata of disease and emasculating the subjective mind of the patient from its bodily environment of suffering. This form of hypnosis demands complete relaxation on the part of the operator as well as the subject, and by reason of the universal status of the patient and physician, above noted, can be the more generally used and with more far-reaching results. In it there is no subtending of the will, no exhaustion on the part of the patient or operator. It is that form of hypnotic effort demanding no fixity or tension of will power, and depends only upon constant iteration and reiteration of suggestions, oral or mental, of the directing mind of the operator upon the subject. It yields most brilliant and oftentimes most astonishing results, and depends upon a fact in psychism denominated as telepathy. Telepathy * is defined as "the power of one mind to communicate intelligence to another otherwise than through the recognized channels of the senses." That this faculty is inherent in man is no longer a matter of supposition, for it is universally prevalent, and is of as much value in hypnotism as the law of suggestion and the subjective mind. It is through the medium of telepathy that the subjective mind and the subjective symptomata of the patient are recognized. Now, it is to be observed that symptomata of suffering on the part of every patient are known as subjective and objective. Ordinarily objective symptomata are easily noticed as disturbances in bodily pulse, temperature, coloring, secreta, excreta, growth or shrinkage, and means are adopted for their amelioration or effacement. But the subjective symptomata are but little commented upon, and while they may claim the paramount attention of the patient in the gamut of suffering, their verbal or oral announcement is too often ascribed to the nervousness or the imagination of the patient, and too often, therefore, disbelieved by the practitioner. Means adopted for the dissipation of the objective symptoms very often efface the majority of the subjective, but not invariably. If disease symptoms, subjective or objective, are dependent, as it would seem, on disturbances in the equilibrium of nerve action between the cerebro-spinal and sympathetic systems, then these oscillations in nervous energy would account for very many of the subjective symptomata complained of. It is at this point that the aid of the nervous force of the operator, through emphatic and confident oral or mental suggestion, can influence and direct the perverted nervous force of the sufferer and lead it back to the wonted channel of health by commanding the subjective mind to resume its proper control of body function. If the telepathic ability of the operator is complete through training, the vast majority of the subjective symptomata of the patient are easily enunciated by him to the patient, the expectant attention of the latter is closely held, his astonishment, delight, and sometimes fear are aroused, and the confidence of both subject and operator is gained. The amount of information culled by this method is often surprising, as to the ætiology of the patient's condition of ill health, its amount, and the tendency therein toward recovery or death. Of course, the various aids of an objective training are to be employed, such as physiognomical indications, vocal tones, ocular expressions, and an objective examination of the patient is to be always insisted upon, in order to objectively verify the clews obtained in a subjective diagnostic or prognostic reading. Very often the disappearance of this or that symptom can be predicted even to its exact time. This prediction involves, of course, oral or mental suggestions, and at times no one is more astonished at the outcome than the operator himself. It is not always necessary to be within vocal or visual distance of the subject to successfully launch a therapeutic suggestion, nor is it requisite to know or to have met the subject even. Personally, this observation has been proved in actual practice, a remarkable example of which will be presented. To summarize, it may be said that hypnosis takes cognizance of—

(a) The law of suggestion.

(b) The existence of a subjective and an objective mind.

(c) The fact of telepathy—all of which factors are universal; and last, though possibly not least, of—

(d) A medium of communication.

What the latter is, what it consists of, has not yet nor will it be distinctly formulated until the laws of dynamics have been irrefutably settled and agreed upon; but the suggestion is offered that this medium of communication may be something analogous to, if it is not, interplanetary ether. If, as is supposed, that interplanetary ether offers the only reasonable medium for the transmission and transference of light, heat, electricity, or magnetism, from their primary sources in physicism, perhaps it may, indeed, be the manner and way and medium of the transference, broadly speaking, of psychism from point to point or along any distance of greater or lesser extent; for it would seem that this interplanetary ether pervades all things and entities and forces in this universe.

It is customary to adduce a series of cases in actual practice illustrative of the topic discussed. It is ex-

* Thomson Jay Hudson. A Scientific Demonstration of a Future Life.

tremely odious to your reader, by reason of the personality involved in a subject of this nature, to follow the usual custom, since a proper personal modesty shrinks from such an exposure; but, while there is nothing in therapeutic results in the main extremely novel to one who habitually and scientifically studies the phenomena of psychism, yet it may be wise to cite one case in point, since it illustrates so remarkably the power of telepathic suggestion on the subjective mind of the mother of one of our local physicians who was ill unto death, and whose condition of illness, by reason of her age and disease, precluded all hope of recovery by ordinary therapeutic means. This case, indeed, bears corroboration in every essential detail, and through professional desire of my confrère is allowed to be discussed. At the outset it must be said that conversational personalities must be indulged in for purposes of illustration.

On a Thursday evening last summer, about 6:45 o'clock, my colleague called and announced that his mother was dying of gangrene of the right foot. Two weeks previously he had told me that there had developed in the joint of the large toe of her right foot an abscess resulting from a shoe pressure on a bunion, and had sought advice therefor, and also said that she had suffered some years from diabetes mellitus. Here was a case presenting grave constitutional and local lesions. He stated that the local lesion had involved all of the toes, which had turned black and had withered, and that there was a most offensive, tough, and deep slough of the upper portion of the foot, extending to the ankle; that there was an intermittent pulse, atheromatous arterial condition, stupor, anorexia, nausea, no thirst, and a constant desire to die. Her age precluded an operation, as she was of too low a vitality to override such a procedure. "Could I go with him to see her on Saturday."—"Yes; but of what avail, since you think that death is imminent?"—"I don't know, but I want you to see her at all events."—"Does she suffer any pain?"—"No; that is just the trouble. She betrays no reaction, and, being so, I consider the case hopeless."—"If we could bring on a reaction of her nervous system," I tentatively suggested, "and arouse her with pain, without additional shock, perhaps something could be done."—"That is just the point, but I do not see how you can do it." This last remark of his gave me a clew to follow in hypnotism. "Where does your mother live? How far from here, and in what direction?" He pointed out the direction and told me sixteen miles, and her place of residence. "Are you willing that I try hypnotism on your mother, for I have an idea that it may do her some good?"—"Yes; but you will have to wait until we go Saturday, won't you?"—No; there is one way we may reach the patient."—"What is that?"—"Telepathy," I answered. Thereat he laughed outright. This nettled me. "Fix your mind on your mother. Get her image mentally impressed as you last saw her this afternoon, and I will not only describe her appearance, face, and position in bed, but the room, and its location and surroundings." He laughingly did so, saying he was ready. In all, save one particular, the patient and locale were correctly described. This assured me that the way was open for success. "Now, give me your hand. To get here to my office you travel in such a circuit and such a direction. It will only be necessary for me to retrace your steps to get there in mind."—"Now, what time is it?"—"Quarter past seven."

At once, with all the power I could summon, and retracing in my mind the path he had taken to come to my office from his mother, I launched upon the subjective mind of the patient the suggestion that she should at once suffer pain and continual pain in the right foot, and that her bodily functions should be restored. We took the time, and agreed that we would question the patient's husband as to the probability of pain occurring near 7:15 o'clock Thursday evening, and whether she suffered more pain from that time up to Saturday on our arrival than she had previously exhibited. The doctor left skeptical, but I persisted in saying that I believed the experiment would be a success and that we would find that she would complain continually, while awake, of the pain. On our arrival the father told us she was worse. "Has she suffered much pain?"—"Oh, yes."—"When did the pain come on?"—"Somewhere between seven and eight o'clock Thursday evening, but nearer seven than eight." Getting bandages and material ready, the father, the doctor, and myself entered the room, and with no especial care and unnoticed by the patient. She lay in a stupor on her left side, her back toward us. The father stood at the foot of the bed, the doctor next at the side, and I near the head. I asked the two gentlemen to join hands, and the father to extend his right hand over his wife's foot. "Now, when I am ready, please notice what you both feel and observe the patient." I mentally, emphatically and confidently, commanded the patient to suffer pain, and that her subjective mind should resume control of her functions, that she should get well, and commanded aloud. "Now suffer pain, pain, reaction." The father felt a shock, the doctor nothing, the mother at once turned on her back with the cry, which I can never forget, dramatic in its intensity, "Oh, what are you doing that you make me suffer so much pain? I can't stand it! I want to die!" Her foot and limb twitched spasmodically with the agony she was suffering. "What have you to say now, doctor, to this form of hypnotism and its effect?"—"I don't know, it is beyond my understanding." The father wonderingly exclaimed, "It is mighty strange. It is wonderful." So far I was satisfied, but when I saw the foot unbandaged and recognized the gravity of the case, my objective training through my objective mind said: "No, she cannot recover." My subjective mind said: "You must gather courage and not yield to the autosuggestion of your objective mind, or she will die." While the foot was dressed I stood at the foot of the bed and mentally and orally commanded that the foot should freely discharge pus until we returned on Monday. As we were returning home the doctor asked: "Well, what do you think? Is she going to get well?"—"My objective training and experience reply No, but if we find on Monday that the foot discharges pus I shall have more hope. My subjective mind assures me, however, that she will get well, against all reason." On Monday the father said: "The foot has discharged more pus between Saturday and to-day than during the previous two weeks, but she won't take my medicine. She says it is a sin to keep her alive when she wants to die and get rid of so much pain."

The difficulty in treating this case hypnotically lay in the fact that the patient, through her own autosuggestion that she would die, strongly militated the suggestive command of the consultant that she must get well whether she wished it or not, and was an autosuggestion that had to be continually fought by your reader throughout the entire conduct of the case. Her mind was affected through the double lesion and the toxæmia, and she has no recollection of the events and symptoms that marked her illness. For several long weeks three weekly visits were made, when gradual hypnotic control was gained over the patient, and the continual, emphatic, and confident suggestions were made that she should recover, and enjoy the rest of her life in comfort. I am assured by her son that she has greatly changed in appearance, that she enjoys life, and that the sugar has markedly lessened. The contour of the foot is restored, with the exception of the loss of all the toes except the big one.

This case illustrates the possibilities of hypnotism, wherein one had not the normal waking intelligence of the subject on which to more easily hypnotically operate, and no objective mind to help the operator; but it shows, indeed, the paramount importance of the subjective mind in hypnotic effort, evidences the existence of telepathy, and indicates, through the path originally taken to launch the initial suggestion, that there must be a physical medium of communication between mind and mind apart from the media of the special senses; for your reader had never seen the patient, the village, nor the road to the room in which she lay ill unto death.

It must be emphatically stated that the reader does not believe in marvels or modern supernaturalism, but on the contrary does assert that there is always a cause for a therapeutic result, and that there are laws established on a scientific basis capable not only of explaining therapeutic results in hypnotism, but also that there are facts which should establish medical hypnosis on such natural, physical, and mental grounds as to forever debar all ridicule, surmising, or odium from a field of medical research which promises such rich results in the future to therapeutists.

The complex man, being composed of mind and matter, cannot be successfully treated either by drugs alone or suggestion alone; but in this age of sordid materialism there are entirely too great claims made for physicism to the exclusion of psychism, which dominates, it must be concluded, the former.

SMITH'S IMPROVED METHOD OF GRAFTING.

This method of grafting is recommended for fruit or other trees, in the orchard and garden, and especially

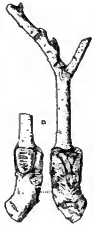


Fig. 1.—An Old and Defective Method of Rind Grafting.

in exposed situations. The scion has a threefold grip of the stock or branch it is placed upon, and this is covered during the first year by the union. The method has been tested in Shropshire and neighboring counties, from my instructions, and has proved a success during the last three years, a vigorous growth having always followed. It can be employed upon stocks varying in size from half an inch to an inch and a half in diameter, and scions may be made from wood one or two years old in the case of fruit trees.

Fig. 1 represents an old mode of rind grafting, the defects of which can be seen at the place of union. Figs. 2 and 3 illustrate the preparation of stock and scion for the method that I advocate—in the one case upon a small stock and in the other upon a larger one. In Fig. 4 the graft is shown when completed and waxed,

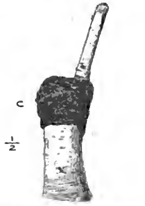


Fig. 4.—A Completed Graft—New Style.

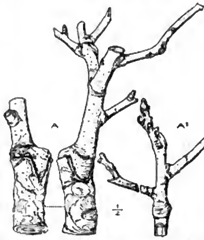


Fig. 5.—Method of Grafting Recommended—Showing the Graft after the First Year's Growth.

and in Fig. 5 is illustrated the effect of one year's growth after the grafting has been done. It will be seen to offer more than ordinary resistance against the wind.—Robert Smith, Horticultural Instructor, Shropshire County Council, in the Gardeners' Chronicle.

THE SIGNIFICANCE OF HOLES IN ARCHÆOLOGY.*

Even now, at the close of this nineteenth century, people, and those not by any means the most ignorant, continue to hoard lucky money—that is, coins in which a hole has been bored by unknown hands. To find or to receive such a coin means good luck far beyond its intrinsic value, for the luck is not so much in the money as in the hole. In this article I propose to show that this present day harmless, but apparently unmeaning, superstition has its root in necromancy or ancestor worship, and can be traced back in various forms, but always in connection with "medicine"†—that is, witch-

* Condensed from an interesting article by Mr. A. W. Buckland, F.A.I., in the Antiquary.

† Throughout this article the term "medicine" is used in the Shamanistic sense, being equivalent to witchcraft, as employed in healing ceremonies by "witch doctors."

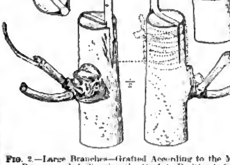


Fig. 2.—Large Branches—Grafted According to the Method Recommended, Showing the Graft in Position before it is Covered with Wax.

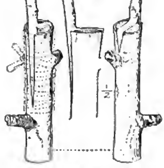


Fig. 3.—Small Branches Grafted, and Ready for Waxing.

craft—to the very earliest ages, probably even to paleolithic times. In various parts of Great Britain we find an analogue of lucky money in various stones known as lucky stones, mare stones, or hag stones, which are very highly valued. Most of these are small pebbles, with natural holes, indentations, or cups in them; they are used for driving away hags or witches, especially the nightmare, which is supposed to be caused by a witch sitting upon the stomach of the sufferer. An abstract from an old book of Queen Elizabeth's time is given in Notes and Queries,* containing "a fonde foolishe" charm for driving away the nightmare. "Take a Flynt Stone that hath a hole of hys owne kinde and hang it over hym." Three of these were exhibited by the Earl of Ducie at a meeting of the Anthropological Institute in 1887, one being remarkable from having two human teeth fixed in the natural hole of the stone. The teeth were probably used to increase the luck of the stone. This mare stone had been in one house seventy years; and similar stones seem to be in common use among the peasants and fisherfolk of the North of Scotland, being kept in the bed to ward off nightmare, hung in byres behind cows to insure safety in calving, or hung on stable doors to prevent horses from being hag ridden. The latter use is, I believe, still common in many parts of England, for I have frequently seen in Wiltshire stones, and sometimes a piece of cork with a hole in it, tied to the keys of the stable. Several of these holed stones used as amulets are described in the catalogue of the National Museum of the Society of Antiquaries of Scotland. Among these amulets we find four amber beads formerly used in Argyllshire as charms for the cure of blindness, and four spindle whorls called adder stones used as charms against diseases of cattle; also a flat oblong stone less than a quarter of an inch thick notched at the edges and pierced with two holes, formerly used as a charm for the cure of diseases in Islay, and two perforated pieces of sandstone found in cowbyres used as a protection for the cattle against witchcraft. In the foreign portion of the same collection is also to be seen a vertebra of a gazelle used in Palestine as a charm against evil spirits. I cite these instances to show that both natural and artificial holes were considered of the same value for the cure of disease and averting witchcraft, and that the same idea may be traced to Palestine.

The Red Indian medicine men, especially among the Cherokees, use beads to symbolize persons, and their shamans take beads and with them work spells for the benefit of their employer, and for the destruction of his enemies. Red is the lucky color and black the emblem of death. By some extraordinary manipulation these beads are made to move up and down the outstretched fingers of the shaman, and by their movements the success or failure of the spell is foretold. A certain formula or prayer is used to invoke success upon the client, the red bead being held between the finger and thumb of the right hand, while a black bead typifying the victim is held in the left. Curses are called down upon the latter, and then the shaman, stooping down, makes a hole in the ground with his finger, "drops into it the fatal black bead, and buries it out of sight with a stamp of the foot."† Purification by water is also associated with this ceremony, the shaman addressing a prayer to the stream near which the incantation takes place, while the client pours the water over his head, or dips in the stream seven times. In gathering medicinal plants, also, the Cherokee medicine man drops a red or white bead into the hole made in pulling up the root, in order, Mr. Mooney thinks, to compensate the earth for the plant torn from her bosom. In the Navajo myth of the creation of the sun, beads play an important part. Two women, known as the Turquoise woman and the White Shell woman, take white and blue beads, draw a circle round them with a crystal dipped in corn pollen, mark them with eyes and mouth, and produce a slight light from the white shell bead and a greater light from the turquoise. These are afterward multiplied by twelve at each of the cardinal points, and with a crystal a circle is drawn round the whole, and the crystal being held over the turquoise face, it lights up and becomes the sun. Here we get the magic circle which always plays such an important part in witchcraft, a survival of which seems still to cling to that symbolic circlet, the wedding ring, which, as we know, is used to cure a sty on the eyelid and other ailments, and to promote dreams.‡ Curative properties are not confined to the wedding ring, for, prior to the Reformation, cramp rings were solemnly blessed by kings of England, and distributed for the benefit of those afflicted with cramp or rheumatism; and silver rings are still worn for the same purpose, while earrings are commonly supposed to be a specific for weak eyes.

Curious instances of the healing properties still attributed to sacred stones in America are given by Mr. Bourke in his very interesting article, entitled "The Medicine Men of the Apache" in the Smithsonian Report of the Bureau of Ethnology (1888). He says that medicine men seem to be subject "to a gradual decadence of their abilities, which can only be rejuvenated by rubbing the back against a sacred stone projecting from the ground in the country of the Walapai, on the Atlantic and Pacific railroad." Another stone of the same kind was formerly used for the same purpose by the medicine men of the Pueblos of Laguna and Acoma, and he adds, "I am unable to say whether or not such recuperative properties were ever ascribed to the medicine stone at the Sioux agency near Standing Rock, South Dak., or to the great stone around which the medicine men of Tusayan marched in solemn procession in their snake dance; but I can say that in the face of the latter, each time that I saw it (at different dates between 1874 and 1881), there was a niche which was filled with votive offerings."

The St. Louis Age of Steel says: "The growth of the British mercantile marine, notwithstanding some recent periods of depression and the general revival of the shipbuilding industries in other countries, has by no means reached the decadence some suppose. In less than a decade the tables show an increase of 3,200,000 tons. A large percentage of this gain is due to the building of large steamships. In speaking of this matter a British contemporary says: 'We have 8,375 steamers of 9,900,000 tons. In fact, in ten years we have added over 6,500,000 tons of steamers, even after all allowance is made for sales, wrecks and waste generally, while the sailing tonnage is actually less than it was ten years ago by 462,000 tons. Antecedent to 1892 the average for some years was nearer 500,000 tons, although, in 1887, a minimum was reached with an addition of 46,600 tons.' That the shipbuilding industry will eventually be more evenly distributed among various nations is a foregone conclusion, and in this inevitable result Great Britain must be the greatest loser from competition."

* Vol. i, p. 34, Series VI.

† See "Sacred Formulas of the Cherokees, Smithsonian Report, 1885," Mooney, pp. 388, 394.

‡ "The healing power of the wedding ring was communicated to the finger upon which it was worn, which was supposed to cure any sore or wound stroked by it, all the other fingers being injurious, and the physicians of Greece and Rome used it to stir their medicines. See Chambers's "Book of Days," February 3.

GLACIERS.

Constructive Work of Glaciers: its Peculiarities—Moraines, Lateral, Medial, Ground and Terminal; Drumlins—Erratics and Perched Blocks.

Constructions by the Combined Work of Ice and Waters—Kames and Eskers—Overwash and Glacial Sand Plains.

THE following are excerpts from a lecture at Wagner Institute, Philadelphia, by Prof. W. B. Scott, of Princeton University.

Glaciers are found in Greenland, Alaska, the Antarctic Continent and elsewhere. A glacier does not move like a mass of ice, by sliding. Gravity is the moving force in both cases; but the ice of a glacier flows—it acts like a plastic body.

The different classifications of glaciers are based on size. We have, in the first place, the Alpine glaciers, because of their typical development in the Alps. They may be compared with small rivers and streams that occupy valleys at first carved out by water, and later occupied by these great streams of ice.

Among the Alps of southeastern Alaska the convergence of a number of streams has produced a glacier covering over 15 square miles of country. The movement of this great glacier is exceedingly sluggish, and in certain parts of it, it does not move at all; there you find it covered many feet deep with soil and rocks; and on parts of it is growing a luxuriant vegetation. It seems impossible to imagine this flora—you can't exactly call them forests, because they are trees and bushes, ferns and May apples, with laurels—growing most luxuriantly with a thousand feet of ice beneath them.

Then we have the great ice sheets comparable to seas of ice. As examples, we have the Greenland glaciers—the great ice cap, which covers thousands of square miles. The whole country from the coast mountains inward is covered a depth of several thousand feet with ice which is gradually flowing outward—eastward and westward to the Atlantic and Baffin's Bay. From this great inland sheet descend glaciers of the Alpine type, which fill the valleys, many of them coming down to the water; many of them ending a mile or so inland.

It is always easy to identify the work of a glacier. The same ice mass will be destructive in one place and reconstructive in another. It is a question of rapidity of flow; so we distinguish in the glacier the central zone and the peripheral zone. The central is where depth and rapidity of flow are at maximum; consequently, no material accumulation is possible at the center. Fifty feet a day is a tremendous movement for a glacier. This comparatively rapid flow carries away all the loose material, sweeping the rocks bare. As the glacier sweeps away this material, a great many stones of all sizes become frozen in the bottom and are dragged and pushed along. The rock bottom is scored; each stone, like a great chisel, cuts and grooves, and the parallel lines are kept perfectly true as long as the stones keep their relative positions.

Then again the glacier makes a curious kind of rock effect, "roche moutons," looking like a flock of sheep lying down. There is one steep side and one gentle side; and you always know that the movement of ice is in this direction—that the gentle side is upstream and the steep side is downstream; because, while you find this side polished by the sand and clay which has been pushed over it by the moving ice, this downstream side, never having been subjected to pressure, may still retain its primeval roughness. Besides the scoring and polishing of the rocks produced by the glacier, it markedly changes the shape of the valleys; an Alpine or valley glacier always changes the character of the valley in which it occurs, such valleys originating through the action of water. The typical form of a stream valley is a V shape, much narrower at the bottom than at the top. The ice filling the valley commences to tear out the sides, and instead of having a V shape, you will get a U shape with a flat bottom. When the glacier has retreated, the valley has a peculiar shape water never gives.

Then a true fjord is unmistakable evidence of glacial action. A fjord is a valley of terrestrial origin which the sea has invaded; and the picturesque beauty of the coasts of Norway, over which travelers are wild, is due to this fact. You have these extraordinarily precipitous-sided rock valleys into which the sea penetrates for many miles, and each one of these fjords is a valley first cut out by water; secondly, modeled by the moving ice into the peculiar glacial forms; and thirdly, submerged so that the sea has come over it. Some of these fjords have two or three thousand feet of water in them. Here, evidently, the fjord has been greatly deepened by the great glaciers which at one time flowed out through them.

The rocks are not solid sheets of material, they are broken up by innumerable joints into blocks; and so, wherever glacial ice would find a block, it would shove it along; and these separate blocks would be worked out one after another and the valley shaped and modeled in this peculiar fashion.

Dealing with the constructive work of glaciers, the North American continent, down to the latitude of 40°, is modified in its topography by the great sheets of ice. In the far north, where the glaciers accumulated and were thickest and swiftest, we have the central zone, with hardly any soil left, as in much of northern Canada, where there is nothing scarcely but naked rock; but from southern Canada to latitude 40 we have a million square miles of country covered to an enormous depth with drift, which is the generic and general term for the material deposited by the great ice sheets; because these were not single valley glaciers, but sheets comparable to those of Greenland and the Antarctic. This drift is of many kinds. The drift's relation to the ice that brought it, whether carried on top of the glacier, in the middle, or shoved along underneath—all these determine the characteristic topographical features which the drift assumes.

So we have the glacial moraines. The scientific study of glaciers began in French Switzerland; and so, just as nearly all our terms regarding volcanoes, so most of our terms regarding glaciers are French. Moraine means the line of rubbish the glacier carries. We have in a valley glacier numbers of moraines—among them, lateral moraines, carried along the side. These are rock masses tumbled down upon the glacier from the cliffs; and if there are no overhanging cliffs—as in Greenland—then you will get no lateral moraine; because there the cliffs are buried out of sight in the enormously thick field of ice. It looks very strange when you first go to Switzerland to see a stream of ice a mile wide, with a great regular line of stones—from a thousand tons down to grains of sand—piled up in long lines in the middle of the glacier, half a mile out from the sides; until you find that the immense moraine is produced by two branch glaciers.

The material underneath the glacier (as long as the glacier moves with some speed) is pushed with it; but when thinned down by melting and you get out into the peripheral zone (with weight and speed reduced) all this stuff is left behind and the glacier rides on over it. This is the ground moraine.

The lower end of a glacier—whether a valley glacier or a great ice sheet—is determined by the point where melting and flow just balance; consequently, when the ice reaches this point, down goes everything that the ice has been carrying; and the great difference between glacial deposits and water deposits is that the ice deposits are entirely unstratified. A glacier, no matter how sluggish its movement, will carry a block of stone that weighs a thousand tons with just as much ease as it does the finest particle of dust; so when the glacier is melted, down goes everything in a promiscuous heap; and you will find these vast bowlders, sand and gravel, earth and soil, all mixed together without the slightest arrangement. That is the terminal moraine.

Besides these, we also get lateral moraines, because, when the glacier is shrinking, it does so not only from the end upward, but from the side, just as a river when its supply of water is diminishing, and it falls, retreats laterally into its channel; so that a glacier that has been filling the valley up to a certain level, when the climate becomes warmer or when the snowfall is diminished, does not cut down so far as it used to, but shrinks laterally, and the lateral moraine is left at one side stranded. The blocks of stone carried on the edges will be left behind. There is a great block of stone in eastern Long Island about half the size of this building; another great bowlder on the edge of a cañon in the plains measuring twenty-four feet in diameter, with estimated weight of twenty thousand tons. Sometimes these great bowlders are let down so gently by the shrinking ice that they make rocking stones, and you may move backward and forward with your hands a great bowlder that weighs a thousand tons or more. There are plenty of such instances.

Besides these general masses of moraine material, there are constructions around, in and underneath the sheet, especially at its edges, produced by the combined work of water and ice. Every stream of ice has water flowing under it. Even in Greenland there are subglacial streams; in the fiercest frosts of an Arctic winter the stream of water issues from underneath the ice. Ice is an excellent non-conductor, and protects the subglacial stream from the action of the intensely cold atmosphere.

Some of these sub-glacial streams are very swift. Glaciers always flow down considerable inclines, where water rushes with torrential violence. They flow through in channels they make by melting their way. In the glaciers great streams flow beneath the lake of ice from the north, pass under its whole length and come out at the south. Many of these streams are under tremendous head, as the engineers would call it, and so loaded with gravel and sand that when they come out to the surface they rise up as huge fountains, sometimes twenty feet high, and, of course, their velocity is immediately checked and they choke themselves with sand and gravel, forcing themselves to melt out new channels.

When the ice has retreated by melting, these subglacial stream channels would be left standing as long, winding ridges of gravel and sand. These have been actually observed in process of formation in Alaska in a glacier which is retreating very fast. In the last hundred years it has gone back a mile or two. It used to be in the sea, and now it is not within a mile of the sea, and instead of the ice-covered area, we have a delta area, where innumerable streams are coming out from the ice and depositing these materials.

In regions like Central New York and New England and Central Illinois we find a great many eskers where these ice streams originally were. These eskers come together exactly like streams, and evidently are old sub-glacial stream channels choked up by the action of the ice. These eskers (or, as they are called in Scandinavia, asar) are a very conspicuous topographical feature.

Another topographical feature produced by the glaciers is kames—short hillocks or ridges of drift gravel, sand and the like formed on the edge of the ice front. These fronts are irregular at the base. A stream of water coming out from under the ice at this point under great pressure spouts up a fountain, throws out sand and gravel and fills up an area with a mass of partially stratified drift, which, when the ice melts and goes back, will be left standing as an isolated hillock or kame.

Drumlins.—Thousands have been found in the glaciated regions of this country. They also have been produced near the edge of the ice front; and their manner of formation is a very complicated one. Below the front of the ice where the escaping waters come out we have the material that these glacial streams were carrying, spread out in sheets. If the subglacial stream happened to find a valley ready to receive it, it flowed down the valley, leaving the coarsest material up at the top and finer and finer as it got down. These

streams of glacial material thus left in the valleys are called valley trains, and are due to the material prepared by the glacier and carried off by the swiftly moving water. If these streams were carried onto a plain, they would deposit most of the material which they would carry. Then we get a glacial sand plain, produced by the waters escaping from under the edge of the ice front.

So we see glacial topography, whether of destruction or construction, is pre-eminently characteristic. It is a mountain flowing torrent with no crags in it. Wherever the ice has overflowed the rocks it has covered them and polished them. Two or three hundred feet is perhaps the limit of height. The winding drumlins all formed in this one kind of way and no other.

THE KLONDIKE GOLD FIELDS.

THERE is always something particularly exciting about the discovery of a new El Dorado; so that when, on July 14, the stories of the fabulous richness of the new Klondike, near the upper Yukon River, just over the border of Alaska, in British America, were confirmed by the arrival of forty miners with gold amounting to over $500,000, an exodus of miners began at once.

The Klondike gold fields are not in Alaskan territory, as was originally supposed; they are in the British provinces in what is known as the "Northwest Territories." The Klondike River, which has been on the map for about twenty years, but not under that name, is a branch of the Yukon River. The gold fields are most easily reached from Chilkoot Inlet. Steamers run there from Sitka and from Seattle and Tacoma. The distance from the head of Chilkoot Inlet to Klondike is about 500 miles. To reach there it is necessary to cross the coast mountains and the chain of lakes and short streams which form the head waters of the Yukon River. It is along these streams the gold is found. The country is a rolling one and is covered with grass and subject to great extremes of heat; so that the mortality among the miners will probably be very high. There is a short, hot summer of four months, with practically no spring or autumn. The ice does not break up until about the last of May, when navigation commences on the Yukon River. By the latter part of September it gets very cool. Winter comes about the first of October, and it is very cold and dry, with little snow and rain. The thermometer sometimes falls 68° below zero in January and February, and sharp winds are prevalent. The dress of the natives and the miners is mostly of fur in winter. Dr. W. H. Dall, one of the curators of the National Museum, who has spent much time in Alaska, states that gold was first discovered there in 1866 and has been taken out in profitable quantities for fifteen years or more, but nothing like the boom of the last few weeks has ever visited the gold fields. The gold bearing belt of northwestern America contains all the gold fields extending into British Columbia and what is known as the Northwest Territories and Alaska. The Yukon really runs along that belt for from 500 to 600 miles, the bed of the river being in the valley. Gold is not found in paying quantities in the main river, but in the small tributary streams which cut through the mountains. In most cases the gold lies at the bottom of thick gravel deposits.

There is another method of reaching the gold fields. This is by the Yukon River, though it is much longer, being 1,500 miles. Flat bottom steamers run from St. Michael's up the Yukon. The return trip is usually made by these steamers. As the gold fields are situated in a country where there is practically nothing upon which to subsist, it is necessary for the miners to carry enough supplies to last a year. Even last winter, when the number of miners was very limited, the supply of food was inadequate, and rations had to be doled out. The several thousand miners who are now on their way to the Klondike, many with inadequate provisions, bid fair to cause one of the greatest catastrophes in mining history. Canada is quite aroused over the discovery of gold in the northwest provinces. Custom house officers and mounted police are being rapidly dispatched toward the frontier.

The miners who have returned to San Francisco bring startling tales of the marvelous finds of gold which discount the stories of 1849. The excitement on the river is indescribable. One man has worked forty square feet of his claim and obtained $40,000 in gold dust. The estimated extent of the district is thirteen square miles, and it is thought that the claims will average $300,000 and some are valued as high as $1,000,000. Labor costs $15 a day and upward. Some of the miners who have returned to San Francisco brought from $80,000 to $150,000 as the result of their few months' work. The method of mining is to remove the surface moss, which is eighteen inches thick, and then build a fire which burns all night. In the morning the gravel is shaved down about two feet; this is shoveled out and another fire is built. In this slow and laborious way the ground is removed to bed rock. This work can be carried on all winter, and there is so much labor connected with it that there is little wonder that the price of employment is so high. All provisions are scarce and dear. Last winter eggs sold at four dollars a dozen and flour at a dollar a pound. It is a curious fact that the Klondike gold is inferior to that obtained in California, or even in other localities near the Yukon. It averages only $15 per ounce, while gold from the regular districts in California averages from $18 to $19 per ounce. As the yield will amount to millions of ounces per annum, the difference is a vast one.

The steamer Excelsior on her next trip from St. Michael's, which will be about September 5, will bring between $5,000,000 and $6,000,000 in gold dust. The transportation companies are taxed to their utmost, and more than five thousand miners are expected to reach Klondike next fall, and it is said that fully twenty thousand would attempt to go there if they were assured of transportation.

The story told by the returned miners is that rich discoveries have also been made in Alaska, just over the border. In fact, it now appears that the rich promise of the whole region has not been a secret among the northern gold hunters during the last few months, but the fame of the Klondike region has become such that every one wished to hurry to that region. It is expected that every mail from Alaska will bring the news of other gold fields which are comparable to those of the Klondike.

THE

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THE CANET RAPID FIRE ARTILLERY.

I. NAVAL GUNS.—M. Canet, now superintendent of the Creusot artillery, after persevering experiments and successive improvements, succeeded a few years ago in constructing a complete naval artillery material, the superiority of which over all others has been demonstrated by experience.

Such material is organized upon the following principles: The bore of the gun is of great length, ranging from 45 to 50 and even 80 calibers. The contours give ample security against flexions or bursting of the chase, a chamber of large size permits of using quite a strong charge, and, by reason of the length of the bore, the initial velocity may reach 800 and even 900 meters per second.

The breech piece is a cylindrical screw, the simple and rapid maneuvering of which is done by a single movement of a lever. It is provided with safety apparatus to prevent a premature discharge and the unscrewing of the breech piece. The extraction of the shells is done progressively by means of a claw, which grasps their base.

The carriage, which is simple and strong, is provided with a hydraulic brake of constant pressure, with a recuperator that permits of obtaining a return to battery sufficiently rapid and without any shock. It is balanced around axes of rotation in such a way as to reduce the stresses of pointing. It permits the piece to recoil according to its axis, whatever be the angle of fire. This material, which is perfectly elaborated in all its parts, and which embraces in its arrangements of detail the latest improvements, comprises guns of 10, 12 and 15 centimeters.

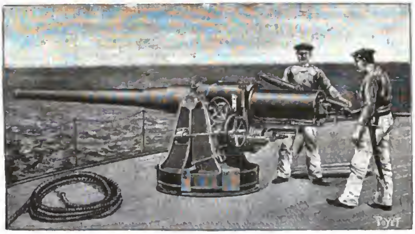


FIG. 1.—CANET 10 CM. RAPID FIRE NAVAL GUN—MODEL OF 1888 (48 CALIBERS.)

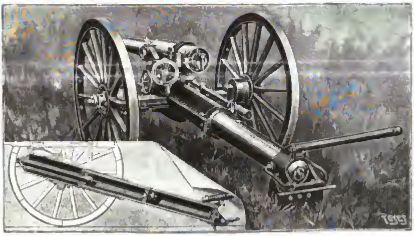


FIG. 2.—CANET 75 MM. RAPID FIRE FIELD GUN.
Piece in firing position. Section of carriage with elastic mounting.

The gun is wholly of steel, and is formed of a tube that extends throughout the length of the piece, of a jacket which rests in the rear against a shoulder piece, and of a conical ring that prolongs the jacket in front. The chamber, in the form of a truncated cone, is united with the cylindrical part through a reinforcing sleeve, and the grooves preserve a constant width up to the muzzle. Their inclination varies from 0 to 6°.

The breech mechanism permits of effecting the three motions of rotation, withdrawal and turning back the breech block at the side through a maneuvering of the screw by a simple movement of the lever in a horizontal plane. The breech is opened through a motion of the maneuvering lever from right to left. At the beginning of the motion, the revolution of the lever around the pivot unscrews the block. The teeth of a bevel gear placed in the posterior cavity are carried along by a pinion with vertical axis fixed to the bracket of the breech block. At the same time, a wheel traverses the circular part of the slide, and a cam carried by the pivot abuts against the posterior edge of the block seat. If the action upon the lever be continued, the pivot as well as the breech screw will be pulled backward. At the end of the motion, the entire system, having become interdependent, will pivot around the axis, and the breech will be open. The closing is likewise effected through a single motion, but in an inverse direction. The firing may be done either mechanically by means of a percussion primer or by electricity.

The carriage has a central pivot and is of limited recoil, with an automatic device to bring it into firing position again. It comprises (1) a sleeve which surrounds a portion of the reinforce of the gun; (2) an oscillating frame upon which the sleeve rests; (3) the carriage, properly so called, of cast steel, formed of two cheeks that support the trunnions of the frame; and (4) of a cast steel base bolted to the deck of the ship and the center of which carries a column of Belleville springs, which are compressed during the firing. The hydraulic brake that limits the recoil and brings the piece back to the firing position is of what is called the "central counter rod system." It consists of a cylinder, of a piston whose rod is fixed in the head, of a valve resting upon the back of the piston through the pressure of springs, and of a rod that enters a central orifice formed in the piston.

The recuperator consists of a piston surrounding the piston rod and of a cross piece carrying two columns of springs.

At the moment of firing, the gun recoils in the sleeve, carrying with it the head and, consequently, the piston. The liquid contained in the brake cylinder is then forced to the front of the piston and passes through the annular orifice between the edges of the central aperture in the piston and rod, whose variable profile permits of regulating at each instant the section of such annular orifice and, consequently, the pressure developed. It afterward passes through orifices formed in the piston and lifts the valve. The recoil of the springs brings the gun back into firing position in forcing the liquid to the end of the piston. The projectiles are of two kinds—an ordinary cast iron shell and a bursting shell of chrome steel. Their brass cartridges, closed at the base by a screw plug, contain the charge of powder.

These guns require but four or five men to maneuver them. They permit of doing the firing with a rapidity that may reach from ten to twelve shots a minute, when no pointing is done, and five or six shots a minute when pointing is done at every shot. The 12 cm gun throws a 25 kg. projectile with an initial ve-

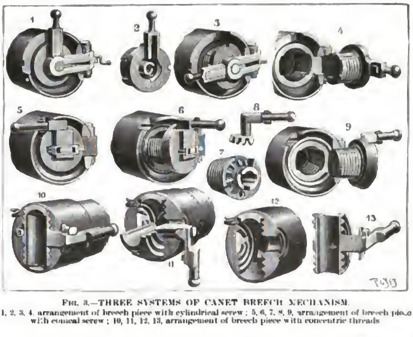


FIG. 3.—THREE SYSTEMS OF CANET BREECH MECHANISM.
1, 2, 3, 4, arrangement of breech piece with cylindrical screw; 5, 6, 7, 8, 9, arrangement of breech piece with conical screw; 10, 11, 12, 13, arrangement of breech piece with concentric threads

locity of 780 meters per second, and the 15 cm. gun throws a 66 kg. one with an initial velocity of 750 meters per second.

II. Field Guns.—The construction of a rapid fire field gun constitutes a problem that is far more complicated than that which concerns a naval, place or siege piece. Nevertheless, after some comparative studies and experiments in firing carried on almost uninterruptedly since 1880, M. Canet has succeeded in constructing a rapid fire field material, all the elements of which have been perfectly combined, and which affords a remarkable solution of the problem from the standpoint of power, mobility and rapidity of firing.

The principles upon which the construction of this material is based are as follows:

The gun, which consists of a tube, reinforced by a long sleeve that receives the breech of a fixing ring and of a ring carrying the trunnions, presents every guarantee of resistance in the longitudinal as well as in the transverse direction.

Three systems of screw closing permit of obtaining rapidity in the maneuvering of the breech block. One of these, which has a cylindrical screw, and the simplified parts of which are capable of being manipulated almost instantaneously without any tool, opens and closes the breech by two successive motions of the lever without releasing the maneuvering handle. The second, which has a conical screw, is maneuvered very rapidly, by a single motion of a lever in one plane. The third, with concentric threads, and entirely new, is maneuvered very simply by a single motion of a lever. The three systems are provided with automatic extractors, that assure the ejection of the brass cartridge shells. All three are equally well adapted for the use of percussion or electric primers. The carriage constitutes a genuine innovation. It is distinguished from the rigid systems in that it almost completely suppresses the lifting and reduces the recoil to a minimum, its length being variable, the fixed part being reduced to the stock, and almost the entire weight participating in the recoil of the piece. The projectiles are separated from the cartridges during carriage, and are inserted rapidly at the moment of firing.

The ammunition is of an entirely new type. The sole projectile is a shrapnel formed of a steel shell containing a series of cast iron disks in which are embedded balls of hardened lead. A central tube permits the fuse to communicate with the charge behind. Around this tube is rammed down an inexplosive material which, at the moment of the bursting, gives out a thick cloud of smoke (visible at a great distance), and which is capable of setting fire to combustible substances. Steel shells of large capacity, with a solid point and with a slow fuse designed to retard the bursting, are reserved for the attack of fortified works. The cartridges are stamped in a single piece out of brass or aluminum. At the base they carry either a percussion or an electric primer.

The Canet guns may be fired with smokeless powder having either nitroglycerine or guncotton as a base. The initial velocity reaches 500 meters in short guns and 600 in long ones of the type of 75 mm. The weights of the guns are respectively 250 and 330 kg.; those of the carriages are 500 and 630 kg.; and those of the shrapnels are 4·6 and 5·2 kg. The maximum range is 5,000 and 6,800 meters.

The rapidity of the firing, in training every time, is ten shots a minute. Such are the principal elements of this material. We cannot enter here into a description of all the details, which have been carefully studied in view of the object to be attained. The material has been submitted to prolonged rolling tests at all speeds over paved roads, and to numerous experiments in firing, at the Hoc proving grounds, and has in all cases behaved admirably.—La Nature.

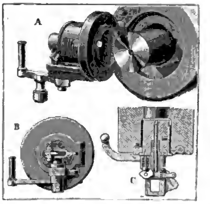


Fig. 4.—BREECH MECHANISM OF THE 10 CM. GUN.

A, the breech open; B, front view; C, horizontal section.

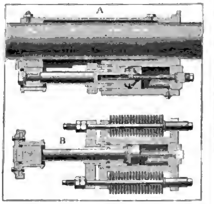


Fig. 5.—HORIZONTAL BRAKE WITH CENTRAL COUNTER ROD AND ITS RECUPERATOR.

A, longitudinal section; B, vertical section.

The rapid fire field artillery of the Canet system, model of 1896, comprises the following guns:

	Heavy material.	Light material.
75 mm. caliber..	Gun of 30 calibers.	Gun of 24 calibers.
70 " ..	" 30 "	" 24 "
65 " ..	" 35 "	" 30 "

The carriage, with elastic tubular mounting, of these guns consists of two principal elements. One of these, which is stationary during the firing, consists of the trail plate and the stock; and the other, which is movable, comprises the part of the frame that slides upon the tubular mounting during the recoil and the return to the firing position, the carriage properly so called, the axle and the wheels.

The stock is formed of a forged steel tube containing a hydropneumatic brake and which enters the tubular mounting after the manner of a telescopic tube. At the end it carries, screwed on firmly by a ring, a trail plate and its accessories.

The tubular mounting carries a circular plate cast in a piece with it upon which rests the gun frame. The latter has two cheeks which are strongly cross braced and connected beneath by a circular plate that corresponds to that of the tubular mounting. The surfaces in contact are trued up with great precision, so as to permit of pointing without any effort.

A maneuvering hand wheel, through an endless screw, moves the toothed sector fixed to the mounting and permits of giving the gun the motions for training in horizontal direction. A second hand wheel, a little to the rear and at the side, controls the mechanism for training in a vertical direction through the intermedium of a pointing box and a vertical screw. The axle, which is of forged iron, and curved at the center, is cranked at its extremities in order to permit of the use of wheels of wide diameter.

The hydropneumatic brake in the interior of the steel tube is of a very simple and strong type that assures the regularity of its operation and requires no looking after.

At the first shot the trail plate enters the earth. An insignificant recoil that does not exceed 50 millimeters, and that varies, moreover, according to the hardness of the ground, occurs at the first shot, and then the trail plate and stock are rendered immovable. At every shot the entire movable part freely recoils, and the tubular mounting slides upon the stock and actuates the brake without the wheels leaving the ground. Then, the energy having been absorbed, the return to a firing position takes place and the carriage resumes the position that it previously occupied.

OUR SEWING MACHINES.

MORE THAN 500,000 MADE BY US ANNUALLY.

America is the sewing machine center of the world, and New York is the center of the sewing machine industry of America. In this city nearly all the great factories producing these machines are directed and controlled, and fully 90 per cent. of the sewing machine trade of the world is managed and handled here. The production amounts to more than 500,000 machines annually, and nearly 100,000 persons in one way or another make their living out of sewing machines, either as factory operatives, agents, clerks, canvassers, collectors, or in some other capacity connected with the making and marketing of machines. One of the largest of the companies has an agency of its own in nearly every city, town and village in the United States, besides being represented by its own agents in every city of importance throughout the world.

The American sewing machine, like the American watch and the American reaper and mower, is the standard of excellence for the civilized world, and the export trade in sewing machines penetrates to the uttermost ends of the earth. New York is the great sewing machine center of the world, because, in addition to being the headquarters of the industry in the United States, it is the home of a company which operates several factories in Europe, among them one in Scotland, where 6,000 persons are employed. The machines manufactured abroad under American patents are not included in the statistics of the export trade, though their manufacture in Europe cuts off our export trade to that extent. Everywhere throughout Christendom the American sewing machine holds the market against all competitors. It is not a question of price, but of merit, quality and reputation. The only country that is making any headway in the struggle for the sewing machine trade is Germany. There they have gone into it seriously, and are turning out machines that show a great improvement over their product of a few years ago.

"Germany is hot after us for the world's market," said a sewing machine exporter to the Sun reporter, "and she is making such excellent machines that the competition threatens to become important to us. German manufacturers have some facilities which Americans do not have for obtaining advances from their banks upon goods consigned to foreign markets, and they can give their commission men six to nine months' credit on all machines handled by them, and the same credit is extended to the buyers wherever they may be located. Here in New York the sewing machines for export are sold for cash, and no credit is extended to the buyer. We are, therefore, at a disadvantage in this respect, and Germany is increasing her foreign trade at our expense. She is making a strong bid for the South American trade and is meeting with considerable success. German efforts to sell sewing machines to France have not fared so well. No matter how cheap the price or how long the credit, the Frenchmen will not buy of their enemy, but keep on taking American machines."

The money value of sewing machine exports for the year 1895, and for the thirty years ending with 1895, was as follows:

	1895.	Total for 30 years.
Austria-Hungary	$12,160	$81,709
Belgium	35,200	790,845
France	98,506	2,645,045
Germany	472,365	15,417,688
Holland	22,018	408,800
Italy	6,750	204,821
Portugal	77	15,088
Russia	....	130,580
Spain	1,814	78,977
Sweden and Norway	8,019	101,658
Switzerland	100	8,729
Turkey	137	23,085
Great Britain	645,847	22,952,623
British North America	111,388	2,122,028
British Australasia	224,875	4,425,036
British West Indies	13,628	241,136
Hayti	4,006	123,428
San Domingo	1,817	70,908
Cuba	16,114	2,241,264
Dutch West Indies	1,069	68,841
Denmark	1,958	31,161
French West Indies	1,849	32,209
Porto Rico	2,290	212,768
Mexico	132,841	4,018,192
Central America	64,970	903,967
British Guiana	8,189	21,192
Dutch Guiana	324	1,044
French Guiana	1,014	5,911
Colombia	30,924	2,620,533
Bolivia	830	3,329
Ecuador	11,402	147,249
Brazil	140,054	2,318,240
Argentina	53,504	1,485,700
Uruguay	13,817	820,784
Venezuela	46,248	970,615
Peru	8,600	488,712
Chile	21,894	500,122
Africa	7,823	102,081
China	3,001	90,817
Japan	3,465	91,622
Hawaii	9,968	269,040
East Indies	1,303	48,028
All other countries	9,277	276,378
Totals	$2,260,189	$67,245,243

For 1896 the total exports were $3,051,108, a gain of $791,089 over the preceding year. There was an increase in the sales to the United Kingdom, British Australasia, Africa, Germany, France and some of the South American countries, and a slight falling in the number of sewing machines sold to Canada. The figures relating to France include only the sewing machine heads, as under the high retaliatory duty enforced in France against American products it is not found profitable to export the iron stands and wooden cabinets. For February, 1897, the total value of machines exported was $244,786. Cuba, which in 1895 took $16,114 worth of sewing machines, in 1896 fell off to $3,061, and this was mostly for attachments, needles, etc. The unhappy Queen of the Antilles, wrapped in the horrors of war, has had little use for anything but food, firearms and ammunition.

The annual average of sewing machine exports during the past ten years has been over $2,500,000 in value. This does not include the 200,000 machines made annually in the Scotch factory already referred to. The same company operates a factory with 4,000 employes at Elizabethport, N. J., and a curious confirmation of the vaunted supremacy of American over foreign labor is found in the fact that the 4,000 Yankees in New Jersey turn out as many machines as do the 6,000 Scotchmen at Kilbowie. Of the total of 13,500,000 machines made by this company from 1853 to the end of 1896, nearly 6,000,000 have been made in factories located abroad, but directly controlled and managed by the New York company. The average value of the exports of sewing machines from the United States indicates that about 150,000 machines are exported annually, and the total number of American machines sold annually in foreign countries, including those made abroad, is equal to the sales in the United States by all the American companies.

"The export trade has been the salvation of the sewing machine industry in the United States," said the president of one of the leading companies. "During the financial depression of the last four years there has been a marked decrease in domestic sales, and sharp competition has affected prices unfavorably. There has been cutting of prices in all directions, and some of the biggest companies have taken a hand in it. The sale of sewing machines at cut prices by the large department stores has had a demoralizing effect, and it is not to be denied that some very excellent machines are being marketed in this way at low figures. So far the big standard companies have kept their machines out of the department stores, but they would have found it difficult to keep their factories running on full time if it had not been for the export demand."

There have been great fortunes made and great fortunes missed in the sewing machine industry. Elias Howe realized over $1,600,000 in royalties and license fees for his inventions and improvements, and Isaac M. Singer lived to see the business of which he was the founder develop into colossal proportions from the investment of $40 and no end of patience, perseverance and skill, from which the sewing machine industry started a little less than half a century ago. Other men have grown rich in the business, and from its development and operation vast additions have been made to the wealth and prosperity of the country. Howe and Singer seem to have been the only ones among the earliest inventors who reaped substantial rewards. The others lacked the faith and persistence to perfect and utilize their ideas, and so missed their great chances in life.

As long ago as 1851 New York became the sewing machine center of the universe, and has steadily maintained that position to the present time. Factories were located in other cities, but their headquarters were in New York, and the commercial end of the business was always transacted here. At an early date

Orlando B. Potter became identified with the sewing machine industry, but he retired in 1875, several years before his death. In the litigation growing out of the infringement of Howe's patents, Messrs. Jordan & Clark, a New York law firm, were employed as counsel by I. M. Singer & Company in 1851. At that time Ambrose L. Jordan was attorney-general of New York State, and the sewing machine suits were looked after by his partner, Edward Clark. The clients were too poor to pay the large costs and counsel fees which accrued in the course of the litigation, and in payment for his services and for money advanced Mr. Clark accepted an interest in the firm, and in 1852 took charge of the legal and financial branch of the business. It was he who, in 1856, instituted the system of selling sewing machines on the installment plan. This, it is believed, was the inception of a system that has now become universal and all-embracing in its scope. From 1876 to 1882, the date of his death, Mr. Clark served as president of the wealthy and prosperous corporation which he had served as attorney in its impecunious days.

It is now twenty years since the expiration of the last important patent on a fundamental principle of the sewing machine; but the inventive genius of the age has not been idle all this time, and patents covering devices of greater or less utility have been granted in large numbers. From February 21, 1842, to September 10, 1895, there were issued by the United States 7,439 patents for sewing machines and accessories. Many of these patents cover several minor features of the sewing machine. So that the aggregate of patented inventions is much larger than 7,439. Among the patents issued during the fifty-four years ending with 1895 were the following:

Sewing machines making the chain stitch	433
Sewing machines making the lock stitch	661
Sewing machines for stitching leather....	431
Machines for sewing on buttons...	88
Machines for making buttonholes	448
Feeding devices	316
Miscellaneous parts of sewing machines..	2,930
Attachments, rufflers, hemmers, corders, etc....	1,524
Cabinet cases and tables	473
Motors, foot, hand, steam, electric.......	170

The earlier machines had no driving power except the common hand crank. This involved the use of the right hand, and only the left hand could be used for managing and guiding the material to be sewed. Isaac Singer conceived the idea of using a treadle similar to that employed on the old spinning wheel, and also discovered that with the addition of a balance wheel on the upper shaft for increasing the momentum he could run his machine by foot power. Soon after came the iron stand with the rocking treadle for both feet. Mr. Singer missed a great chance here. He did not realize the supreme value of these discoveries, and so neglected to take out patents. Two years later, when his devices had become public property, he saw the lost opportunity. One of the latest devices for driving a sewing machine is a revolving treadle with the bicycle movement, but none of the new wrinkles have proved so satisfactory as the old fashioned rocking treadle.

The proportion of hand to foot power sewing machines used in Europe and in Asiatic countries is far greater than in the United States. The operation of a sewing machine by hand power in this country is exceptional and is usually confined to those in some manner crippled or physically unable to apply foot power. In Europe and Asia much of the sewing machine work is done by peripatetic operatives who travel from house to house and carry along their own machines, and as they find the iron stands and wooden cabinets an impediment they prefer the hand power machine that can be rested on a table, bench or box.

In no branch of manufactures has a greater revolution been wrought by the sewing machine than in boots and shoes. By its aid the quality, style, and value of footwear have been greatly enhanced, while prices have steadily declined, until there is no nation on earth to-day whose people are so well and so cheaply shod as are the people of the United States. Changes in shoemaking methods and processes have been most radical. Formerly the fitting of the uppers was accomplished by sending them out in small quantities to be sewed and stitched by hand in the homes of the operatives. When sewing machines were introduced the scattered home industry was concentrated in factories, and steam power was employed for driving the machines. In 1861 the first machine for sewing on soles was put into successful operation, and a royalty of two cents on each pair of shoes was exacted by the owners of the patent. They must have had a liberal income from this source, as in one day of ten hours 900 pairs of shoes could be sewed on one machine, and by the aid of machines 350,000,000 pairs of shoes had been made up to the year 1877 in the United States, and probably an equal or greater number in Europe. The machine now in general use does its work in a manner closely resembling hand sewing, and is sold on a royalty plan based on the rate of production. This machine is considered one of the marvels of an age of mechanism. It is said that after examining the operation of the sewing and welting machine of to-day Thomas A. Edison declared it to rank equal with the Blanchard lathe in ingenuity and importance. Certain it is that a shoe which can be bought at retail for $3 is in all respects equal and in many respects superior to the $5 shoe of fifteen or twenty years ago. Another effect of machinery has been to greatly increase the finish and beauty of ready made shoes.

Button hole machines have also had a large sale on the royalty plan, and have been very remunerative to the owners of the patents.

During the early years of the sewing machine, the custom tailors showed great prejudice against its use, but this prejudice has wholly disappeared, and the machine is now in general use for making the finest garments. The enormous increase during the past ten years in the factory production of clothing has been coincident with and largely the result of the invention of special appliances and attachments adapting the sewing machine to factory operations in the performance of all stitching processes, including button hole and eylet making, attaching buttons, staying seams, etc. From 1880 to 1890 there was an increase from 6,166 to 18,658 in the number of establishments in the United States devoted to the manufacture of men's clothing, and during the same decade the number of establishments devoted to women's clothing increased from 562 to 20,811. The last mentioned figure includes custom dressmaking establishments having a product of over $500 in value, whereas the smaller figure for 1880 does not include the custom dressmaking establishments.

The concentration of the manufacture of clothing into factory operation, alone made possible by the sewing machine, has effected some important economies in the marketing of the cloths, especially the cheaper fabrics, such as jeans, denims, shirtings, etc. These goods are now sent directly from the mills to the factories where overalls, shirts and other articles of clothing are made, and no longer pass through the hands of the selling agent, the commission man, the wholesaler, the jobber and the retailer, each of whom formerly enjoyed his slice of profit in the handling. The extent to which wearing apparel of all kinds has been cheapened in consequence of the sewing machine could be expressed only by figures running far into hundreds of millions.

It is also an interesting fact that while the large manufacturing industries dependent upon the sewing machine much more than doubled their output from 1880 to 1890, the population of the country only increased one-quarter. It therefore follows that the quantity of sewing done in the home has been greatly reduced and the cost to the consumer of sewing machine products greatly lessened. A man well informed in the sewing machine trade on a large scale said to the Sun reporter:

"It is in the use of sewing machines in factories that the greatest revolution has been effected. You will doubtless be surprised when I tell you that the sewing machine in the home, taking the rich, the well to do, the families of the well paid wage earners, and the poorest of the poor altogether, does not average over twenty hours in the whole year. It is no longer used at home for making garments; the factories produce these at a price so little in excess of the cost of the cloth that it is no object for the housewife, be her circumstances ever so straitened, to employ her time in making clothes for the members of her family. Women at home use their sewing machines only for an occasional bit of stitching, and while none of them would consent to be without a machine, the use of it is surprisingly small. This is one of the greatest boons conferred upon women by the sewing machine, for it has left them leisure for other employments or enjoyments."

In the census reports relating to the principal manufacturing industries that use the sewing machine largely, the figures show that the total value of their products in 1890 had increased about 75 per cent. as compared with the value of their products in 1880. These industries employed 661,000 hands in 1890; they had about $437,000,000 invested in machinery, tools, and implements of all kinds, and the total value of their product was $1,161,196,850. The manufactures in which sewing machines are essential are awnings, tents, sails, bags, bookbinding, boots and shoes, clothing for men and women, corsets, flags, banners, men's furnishing goods, gloves, mittens, hats, caps, pocketbooks, rubber and elastic goods, shirts, saddlery and harness, and horse clothing.

The reports of the sales of sewing machines during 1873-76, the period of the "sewing machine combination," which was entered into by the leading manufacturers twenty-four years ago, show a total of 2,303,041 the average a year being about 576,000. Since 1876 there has been no available information other than that indicated in the census reports. These figures indicate that the average number of machines made annually during the last twenty years in the United States has been from 500,000 to 800,000, and that the average first cost per machine has been about $20.

A comparison of the census reports of 1880 and 1890 shows a decrease of 50 per cent. in the number of establishments engaged in the manufacture of sewing machines, but it also shows that there has been no perceptible decrease in the number of persons employed, and that their average wages had increased about 10 per cent. during the decade. In 1880 the average wages were $485, and in 1890, $567 per annum. The reports from fifty six establishments in 1890 showed the employment of 9,121 operatives, whose wages amounted to $5,170,555. The market value of their product was $12,823,117, so that the item of labor constituted about 40 per cent. of the total value. The relative figures have not changed materially during the last seven years. It is estimated that at present about 10,000 operatives are employed in the sewing machine factories of the United States and that the number of machines produced is but little in excess of 900,000. The average rate of wages is about the same as in 1890.

Nearly all of the large sewing machine factories of the United States are located within a few hours' ride of New York City, and this city is in effect the point of departure of the great bulk of sewing machine shipments. Scarcely a steamship clears from this port for any part of the world but carries one or more American sewing machines, while large numbers destined for China, Japan and Australia are shipped in sailing vessels on account of lower freight rates.

Until recently, the machines sent to foreign countries were of the plainer styles, but within the last year or two, there has come a demand for handsomer frames and cabinets, and the average price paid has increased correspondingly.—New York Sun.

THE SHEATHED PROPELLER.

Since the introduction of steam navigation, traffic by sea has undergone as great changes as that by land has experienced since the opening of the first railway line. It has long been a problem to find some suitable contrivance by which sailing vessels might, in times of calm or of contrary winds, by the help of auxiliary engines, continue their course.

THE PROPELLER UNSHEATHED.

THE PROPELLER READY FOR USE.

Most freight vessels carry both sails and machinery nowadays, but we need not consider these, as the subject of our article concerns smaller craft only.

The Sheathing Propeller Company, of London, has lately put on the market a small propeller of peculiar construction. Our two illustrations, which we have borrowed from Der Stein der Weisen, will serve to show its construction. We see in the first cut the usual semicircular opening in the rudder and the propeller shaft emerging from a steel casing. The propeller itself is not set in position for use, but the two wings or blades are folded in an axial position. To make this possible they are hinged in a spherical head, which, on the side furthest away from the ship, has a slot permitting the two blades of the propeller to move in a plane extending longitudinally of the shaft. In our second cut we have the propeller opened, ready for use. When the ship is sailing by wind or is at rest the whole contrivance can be drawn back into the tubular casing of the shaft. The same company also makes a somewhat similar propeller which is, however, drawn in fully opened into a receptacle of corresponding dimensions. But this modification offers far less advantages. The first objection is perhaps the considerable space required, which might of course be used for other purposes. Besides, when the propeller is not in use, it causes quite an appreciable resistance, which, of course, lowers the rate of progress attained under sail.

But the first mentioned form will certainly be found most useful by many classes of ship owners.

Sportsmen will, no doubt, object to having on board machinery of any sort, be it only a small benzoline motor. But for fishing smacks, small merchant sail-

ing vessels, and even for large steamers, the folding propeller will be a very advantageous acquisition.

Hitherto steam has been useless as a means of propulsion to fishermen, as the screw or paddle would get caught in the nets and ropes, and not only foil all attempts at pursuing their business, but cause considerable trouble, and perhaps some danger. Such difficulties are avoided by the propeller shown in our cut.

We stated above that it would also be of great use to smaller merchant vessels constructed to carry sails. Such are usually supplied with some machinery for loading purposes, for hoisting sails, moving heavy articles, etc., and these engines would be quite sufficient to work the light propeller; so that the danger of a stoppage in a dead calm, and the commercial loss in such cases, would be avoided. But even if there is no steam power on board, a small motor of any description will do the work quite satisfactorily, and the owner would have an almost unlimited variety to pick from.

As for the advantage gained by providing large steamers with one or several such propellers, it will occur to every one who calls to mind the difficulties that our large vessels have in landing and coming alongside the docks or piers. The cause of all this trouble is that, when the boat is nearly stopped, it no longer obeys the rudder, and so towing has often to be resorted to. If, besides the main propeller, there were two smaller screws, one on each side, this difficulty would be overcome. For, by working only one of them, a curved course might be given to the boat. Besides, of course, there is always a possibility of damage to the main propeller, and in such emergencies the sheathed screws would of course be resorted to. It is also said that the lurching and rolling of fast running boats could to a great extent be mitigated by the use of two auxiliary screws.

The sheathed propeller would then be used with great advantage on all kinds of craft—the fishing smack, merchant sailing vessel, passenger and freight steamer, and even the man-of-war would each be benefited in her own way.

All parts of the screw which come in contact with sea water are made of bronze, gun metal and other appropriate alloys. The company has constructed models of ships fitted with their propeller up to several horse power, providing the inquirer with plans, information and directions concerning the use and installation of its goods.

THE NEW BRIDGE OF ST. LOUIS AT SENEGAL.

A NEW metallic bridge has recently been completed over the River Senegal, replacing the old wooden pontoon bridge established by General Faidherbe. Both bridges are distinctly shown in the illustration published herewith, for which we are indebted to Le Monde Illustré. The old bridge is a flimsy-looking affair, which might be readily carried away by even a moderate flood. The last section of the new bridge is ready to be floated into position.

The bridge is 600 meters long and was built by the Nogier & Kesler Company, to whom the work was allotted by the Committee on Adjudication. The contract price was 1,500,000 francs.

The illustrations present an interesting contrast of the latest type of bridge construction as compared with the primitive efforts of an earlier date.

THE NEW BRIDGE OF ST. LOUIS AT SENEGAL.

COMMON SENSE AND SCIENCE.

HERR VON MEYENBURG, a Swiss engineer who has been making a tour of the machinery manufacturing centers of the United States, visited Worcester, Mass., and gave a representative of a paper an interview of some length on the things he had observed about the quality of American mechanical genius and of American machinery. Among other things he said: "My object in coming to this country is to buy machinery and thoroughly to investigate the design and construction of American machine making tools. In machine-tool construction America beats the world. The finest lathes, planers and all tools used in the manufacture of other machines can be bought in this country. Foreign manufacturers are beginning to realize this and to buy largely in this country. But on the other hand, the machines and engines which are made with the American labor and with the American tools are vastly inferior to those made in Europe. Some of your finest engines, dynamos, and other machines would not hold a place in the German or Switzerland market any time at all. Your tools are better, but the machines are inferior. It is partly due to the labor, and partly to the men in charge. Labor is so costly here that for the same money you cannot get out equally good machines. You make them too fast, and the finish and construction are not so fine nor so accurate. Then, too, your foremen and master mechanics do not get the training that ours do. I do not want to criticise any one American mechanical school, for they are all alike. A student goes through a course of four years and then is ready to take up his work. In the meantime he has taken a general course in theory and, in addition, has had a smattering of the practical work, a little blacksmithing, a little lathe work, a little welding and a little something else. None of it is complete. In our schools we have a four year course in theory. During that time we do not have a bit of work in the shop, but we study the theory very carefully. We are made to think, instead of gathering a mass of tables and figures in our heads indiscriminately. At the end of the four years we go into the shop and have two years' work there. Then we are ready to take a position.

"As a result, the German master mechanics have a tremendous amount of knowledge and the power to apply it in special cases. But we lack the common sense and personal energy that you have in this country. You have the common sense and quick wittedness, but lack the knowledge of the great principles. It is not the teachers' fault. You have fine teachers here; but the Americans don't want to learn; they don't think. They would rather 'sport,' I think you call it. You don't learn the languages carefully. You think that America beats the world in everything, and that there is no need of studying foreign methods. Now, there are some excellent things in Germany, which can be found out only by reading the original description in German. The reason why American tools are better, while the better machines made with them are found in Europe, is this: Machine-making tools do not involve the great principles that engines, dynamos and great machines do. Tools are really evolved. If a piece is found by experience to be too small, it is made heavier next time. Tools start at a simple stage and are gradually evolved step by step. You, in this country, apply your common sense and make the changes as a matter of course and without much thought, while a German would spend a long time in figuring out the why and wherefore, and would be distanced by his American competitor. In the greater tasks thorough and complete knowledge of the great principle is necessary. Manufacturing interests are greatly on the increase in Europe, and machine tools are being bought in great quantities. It is a great opportunity for the American manufacturers of tools, for the European market cannot supply the demand, and the European manufacturer prefers the American product if he can get it. The American goods are being exported largely, and that is what keeps your machine tool shops so busy in general dullness of trade. The opportunity may not last forever, though, for some time we will get the required common sense, and when we do, our machine tools will be better than yours."

While Herr Von Meyenburg may be partly right, he is evidently partly wrong, and what he says is self-contradictory. Machines are made in accordance with principles. Science is a knowledge of those principles. The mechanics who make the best machines must surely possess more real science than other mechanics who do not make similar machines so well. The over-taught European may have more "theory" than the American engineers, who, he alleges, are undertaught, but he confesses that the undertaught Americans turn out machines that surpass the best products of the overtaught Europeans. If he means anything by this apparently illogical situation, he means that what he calls a "smattering," or too little technical training, is far more desirable and efficient mechanically and commercially than too much technical training, which, according to his view, has stifled "common sense" and dulled the conceptions and perceptions of the unfortunate Europeans subjected to a surfeit of theories. Nor is he any clearer or more convincing in what he says about the products turned out by American and European mechanics. A close comparative study of American and European products in the Columbian Exposition in 1893 absolutely failed to show the European superiority in fineness of work, elegance of design, solidity of construction or perfection of function which Herr Meyenburg claims. Prominent critics awarded the palm of superiority to the American exhibitors there. The German wood and iron working machines shown were models of ugliness and awkwardness, which no American shop would accept as a gift under the provision that they must use them. More than one European engineer, who came to the United States heralded by a great blare of trumpets to revolutionize mechanical work here and show the natives how to do it, has utterly failed, and has either returned to Europe, where "theory" stands in higher regard than "common sense," or else is occupying some obscure position here. It would be unkind to mention specific cases, but we are not willing to let pass such assertions as those of Herr Meyenburg without a comment. The American system of training may have its defects, but certainly it has in it no defect that implies the smother-

ing of common sense. The European system of training may have no defects, so far as it goes, but evidently it needs to go further, and, instead of submerging its victims under a flood of inapplicable theory, have added to it the elements needed to arouse the sleeping "common sense" of men whose work, above all things else, is the embodiment of common sense in tools and machines. Herr Meyenburg reasons or unreasons himself into an illogical situation which is a queer commentary on the lack of "common sense" which he so bemoans in the Europeans in general. His elucidations do not elucidate.—American Woodworker.

MOUNT VERNON, MO., July 16, 1897.

To the Editor of the SCIENTIFIC AMERICAN:

DEAR SIR: I inclose in another package two pieces of glass water tube from the engine and boiler of the flour mill at this place. These are taken from the upper ends of the tube. The engineer has followed his business for about thirty-five years and tells me that this place is the first in which the tops of the tubes have eaten away in the manner shown. He says the water here gives no trouble in the boilers, but that the tubes, unless removed, will blow out in about two months, and all will show the same action in eating or wearing away. The packing and shape of the connections with the boiler is of the ordinary kind. We would like to know what is the trouble, and whether the action is a chemical or mechanical one. Observe that the enamel is gone on the outside and above the gum packing, and the inside of both tubes grooved lengthwise. Why does it eat away the outside of the tube first? The water end of the glass is not affected. There is no current of steam or water passing over the end affected.

The engineer and myself both take your paper, and if you will be so kind as to give us a little light on this subject, you will relieve two very puzzled people.

E. M. ESSEX.

[The subject of your query is explained in the following article by Mr. G. D. Hiscox.—ED.]

CORROSION AND BREAKAGE OF WATER GAGE GLASSES.

By G. D. HISCOX.

THE uncertain quality of water gage glasses and their liability to crack and burst is always a source of apprehension with engineers and firemen. The most important part of a water gage is the glass tube, and upon the perfection of its make and composition depends the confidence with which it is viewed. The defects arise principally from the composition and imperfect annealing, which leaves an unequal strain upon their outer and inner surfaces. Another defect is the gradual weakening of the tube by the solubility of the glass in pure water at the high temperature due to the pressure of steam carried in the boiler.

Before the introduction of the Scotch kelp glass tubes to the American market, water gage glasses were made from tubing of Bohemian, crown or flint glass, as convenient; their durability being very uncertain from the brittleness of the Bohemian glass under changes of temperature and the extreme solubility of the flint glass in contact with high pressure steam. The crown glass was better, but could not always be had in tubing. The introduction of the Scotch kelp glass tubes has made the conditions of breakage and wear more uniform, but with no apparent gain in the soluble properties of the glass.

Thus, by a series of experiments, flint glass has been found readily soluble under a pressure of from 300 to 600 pounds per square inch, at a less temperature than that of boiling water; other experiments have shown that pure water as it condenses from steam at high temperatures and pressures is an active solvent of glass in a degree dependent upon its composition, the greatest affinity being toward the kind of glass containing the greater portions of potash or soda.

Several theories have been named to account for the wearing away at the top and the streaks down the inside, which generally terminate at the water level of the gage glass. Friction of the water of condensation carrying particles of iron, rust and dirt is the most plausible, but it does not account for the cutting away of the outside of the tube at the top, where it projects above the rubber packing and into the chamber of the water gage head. This projection forms a small cistern around the top of the tube, which is a receptacle for the water of condensation on the inner surface of the gage head at a constant temperature and pressure due to the boiler pressure, and which is constantly filling and overflowing and running down the inside of the tube. There being no friction worth consideration in the little cistern around the top of the tube, the only tenable theory for so great a waste of glass at this point must be found in the soluble power of pure water at the temperature and pressure in the boiler, and that pressure is the potent influence in the process. In support of this last point, we may point to experience with low pressure heating apparatus, for gage glasses that have been in use for several years on low pressure boilers of less than five pounds pressure have been removed with scarcely a mark of corrosion.

The cracking of water gage glasses may be mainly attributed to the tension of the glass on the inside surface by faulty annealing, as this is shown by the fact that a slight scratch around on the inside surface at the proper place will produce a crack following the scratch. This is the method used for breaking the tubes to the proper length for use, while if the scratch is made on the outside of the tube, it does not crack at the scratch naturally, and if pressure or a light tap is used to start the crack, it will break just where not wanted. This very plainly shows that there is compression on the outside and tension on the inside surface of the tube.

This is also manifest in the care necessary in cleaning the tubes by wiping, as every engineer knows by teaching or experience of the final cracking or splitting of the tube when an iron rod or wire is used for pushing the wad through the tube. Unless the whole rod is wound with a strip of cloth to prevent scratching, the contact from a scale or particle of grit may make a scratch that cannot be seen by the eye, but will soon split the tube when exposed to changes of temperature in the water gage. In this way a very curious phenomenon has been observed in the cracking of tubes in a spiral line for the greater part of their length. The cause of this has been traced to the fact that the construction of the water gage heads sometimes produces a whirl in the steam inside of the glass when it is blown off at the bottom. Any scale or other hard substance from the inside surface of the top connecting pipe partakes of the whirling motion of the steam, and the centrifugal force presses the particles against the inside surface with a sufficient force to produce a spiral scratch not noticeable at the time, but soon starts a crack that, as has been observed, ran on a spiral more than once around the tube.

Another source of trouble by breakage is from unequal expansion between the glass and the ironwork, especially if the water gage heads are screwed directly into the shell of a vertical or locomotive boiler. The expansion and contraction of the boiler plate is about 40 per cent. greater than that of glass for even changes of temperature; but as the glass tube below the water line may be somewhat cooler than the boiler plate, the difference in expansion may be greater than here stated. This strain constantly changing from day to day or week to week, presuming that the rubber packings have become hard or vulcanized to the glass, as is often the case, the contact becoming closer and with a longer bearing, from the screwing of the stuffing boxes too tight at first, or following up the cap to stop leaks, makes an immovable connection between the glass and the gage head that finally throws the whole strain from expansion upon the tube, which, with the natural tension upon the inner surface, pulls the tube apart.

When water gages are placed on columns of cast iron free from contact with the boiler, except by their connecting pipes, and care is used in squeezing the rubber packing rings lightly or only just enough to prevent leakage, there is far less trouble from breakage. By this arrangement the cast iron column is kept slightly cooler by the slower circulation of the inclosed water, and the cast iron also having a slightly less expansion than wrought iron for given changes in temperature, makes this method of water gage connection much the most reliable for safety as well as the steadiest indication of the water level in the boiler.

Where water gages are connected to the cast iron front with pipe connections to the boiler, corrosion of the gage glass seems to be largely increased, as observed, and also from the fact of the increased flow of hot water and iron rust through the glass from condensation in the usually bare pipe from the boiler. This is relieved in a great measure by the use of the independent stand pipe, which should be required by purchasers of boilers of any style in use.

FLOATING GRAIN ELEVATOR.

WE illustrate herewith a grain elevator constructed by Messrs. S. S. Stott & Company, of the Laneside Foundry, Haslingden, near Manchester, a firm which has long been associated with this type of engineering. This elevator was made for Russia, the grain being taken from one barge and passed into one of either of several barges lying alongside each other. In both cases the apparatus is on the endless chain and bucket system, the series of elevators is the same, although in the latter instance the grain is deposited in a "boot," and conveyed thence to the barges; in the other it is again raised and discharged by conveyor and gravitation into a ship's hold. The trestle shown in the engraving usually runs on rails laid on a barge 12 ft. or so wide; hence the name, a floating elevator. The boiler for supplying steam to the engine driving the elevators and conveyors is placed on deck or between decks; but this is a matter of arrangement according to requirements.

The framing of the trestle consists of T and angle irons with cross and diagonal stays, and it is carried on 18 in. wheels running on rails. The system of conveyors will at once be appreciated from the engraving. The grain is elevated from the barge which is supposed to be moored to the left of the engraving, carried along a conveyor, and discharged through a shoot into a boot at the bottom of the trestle, is thence raised by another elevator discharging through a telescopic shoot into the hold of the vessel. The apparatus illustrated has an overhang of 20 ft. into the barge. The elevators are extended from the outer ends of a pair of derrick arms. The elevator for the apparatus to discharge 60 tons per hour has buckets 15 in. long; for the machine delivering 100 tons per hour they are 18 in. long. They are carried by double lines of detachable link chain, 9 in. to 12 in. apart. These chains are operated by sprocket wheels at either end; these rotate in gun metal bearings secured to the sides of the elevator trunk or casing, built up of timber with steel bracing and angle irons. The tension on the chain is provided by a screw and nut fitted to the bottom bearings. For this purpose the bearings on either side are fitted into sliding frames 12 in. long, and through each there is a square threaded screw for the purpose of making the chain taut. At the top of the screw there is bevel gear to connect the screws on either side, so that both will act simultaneously. Inside the trunk the chain guides are of timber faced with steel, which can easily be renewed. At the bottom there is a 2 in. steel grid to prevent the buckets being damaged.

The grain is delivered from this elevator through a small hopper into the conveyor leading to the boot in the bottom of the trestle. To insure a readier delivery, there is a guide or backing pulley just under the point where the elevator tips its load. The conveyor is 20 ft. long. This determines the amount of overhang of the elevator so far as the barge is concerned. The band conveyor is supported on two wrought iron derrick arms of channel sections, with trunnions on each end, so as to swivel at both ends. These are supported at the outer end by steel wire ropes passing over pulleys at the head of the trestle to a power-driven crab on the platform on the trestle. The trunnions enable the derrick arms and the barge elevator to be drawn up in a vertical position alongside the trestle when not in use. The inclination at which the conveyor between the derrick arms will work varies from 15 deg. in an upward direction to 30 deg. downward. The band conveyor consists of an endless band of cotton 21 in. wide, passing round pulleys at each end, and supported by intermediate steel rollers about 5 ft. pitch. Angle steel rollers are attached to the sides of the conveyor for giving the necessary curvature. The framing supporting the pulleys is of timber. When desirable, the grain is protected from the weather by means of tarpaulins carried on T-irons, which are shown in the engraving.

GRAIN ELEVATOR FOR RUSSIA.

The grain flows from the conveyor into a shoot built up of timber lined with steel, thence into the boot of the fixed vertical elevator carried upon the trestle. The elevator does not differ materially from the one which is suspended on the derricks for use in the hold of the barges. In the case of the 100 ton apparatus, it is able to discharge to a height of 25 ft. above water level, and even then the conveyor into the ship's hold might be placed at a slight upward angle, although obviously this would only be resorted to under exceptional circumstances. It is very unusual to find a ship with her fixed bulwark more than 25 ft. above water level. The telescopic shoot, or conveyor, into the hold of the ship, as the case may be, is also arranged to swivel fore and aft; but this necessitates in the case of a belt conveyor somewhat elaborate gear. This swivel gear is fixed to the side of the trestle, and consists of a cast iron frame with bevel and spur gearing. The sprocket wheel for driving the belt first actuates a horizontal shaft which through bevel gearing and a vertical shaft finally rotates a second horizontal shaft. This latter by spur gearing actuates the end shaft carrying the traveling drum around which the

belt travels. Thus the two horizontal shafts need not be parallel, the vertical shaft transmitting motion from the first horizontal shaft to the conveyor. This conveyor is usually about 25 ft. long in both 60 and 100 ton apparatus. Sometimes, as we have said, there is substituted a telescopic shoot constructed of steel plates, and about 30 ft. long, opening out in 10 ft. lengths. This, of course, can only be used when the vessel is lower than the top of the trestle of the conveyor.

Two 60 ton machines are not infrequently mounted upon one barge, in which case the power plant consists of a horizontal multitubular boiler, 7 ft. 6 in. in diameter by 7 ft. long, furnishing steam to two small horizontal steam engines, each with two cylinders, 7 in. bore by 12 in. stroke, the actual power required for both machines not being more than 20 indicated horse. The 100 ton machine is driven by a horizontal steam engine with two cylinders 9 in. bore by 15 in. stroke, steam being supplied by a horizontal multitubular boiler, 7 ft. in diameter by 7 ft. 6 in. long. The actual power required for driving a 100 ton machine is not more than 15 indicated horse. The engine drives a shaft with bearings on the deck of the barge, and extending the whole length of the railway on which the trestle is traversed. Power is transmitted from this shaft by wheels and detachable chain to a second shaft, fixed as shown on the traveling trestle. Similar chain gearing drives the shaft on the derrick arms, whence power is derived for the swiveling of the derricks, for driving the conveyor and the bucket chains of the elevator, as well as of the fixed elevator. Detachable chains are used in all cases, and where there are vertical drives tension wheels are introduced. For driving the fixed elevator power is taken from the same shaft to a shaft at the top of the trestle, which also drives the conveyor, extending over to the hatch of the ship. The sprocket wheels are all of steel. Inside the elevators the chain is of 2½ in. pitch in the case of the 60 ton apparatus and 3 in. in the 100 ton plant. The drive chain is 3 in. pitch, but the main drive from the engine shaft is 3½ in. pitch. The chains in the 60 ton elevator are constructed for a working strain of 850 lb., and in the 100 ton machine 1,500 lb.

On a platform of the trestle is a crab driven by two belts from the main shaft, so fitted as to give reversing motion, with one fast and two loose pulleys. All the wheels are of steel, the bearings of gun metal; sprocket gear is preferred, as it is unaffected by weather. All timber subject to the wearing action of the grain is steel-lined. The trestle wheels are driven by spur and pinion gear; the gage is usually 10 ft., and there are four wheels. The barges themselves are from 60 ft. to 100 ft. long, from 15 ft. to 20 ft. wide and about 10 ft. deep.

A special feature is that the apparatus is bolted to the deck, and that the grain is conveyed from one barge to another or on shore; and thus, instead of the band conveyor from the movable elevator, there is a steel telescopic shoot delivering into a hopper under which there passes a band conveyor which is led to the barge or on shore. The distance the grain may thus be conveyed is not limited, as several belt conveyors can be laid one under the end of the other. The order carried out by Messrs. Stott in this case was for conveyors to traverse 95 ft. from the foot of the elevator.—Engineering.

PHOSPHOR BRONZE.*

By Max H. Wickhorst.

Bronze is an alloy of copper and tin. Phosphor bronze is bronze containing varying amounts of phosphorus, from a few hundredths of 1 per cent. to 1 or 2 per cent. Bronze containing simply copper and tin is very liable to be defective from the presence of oxygen, sulphur, or occluded gases. Oxygen causes the metal to be spongy and weak. Sulphur and occluded gases cause porosity. Oxygen gets into the metal by absorption from the air. It can be eliminated by adding to the metal something which combines with the oxygen and then fluxes off. Such deoxidizers are zinc, antimony, aluminum, manganese, silicon, and phosphorus. Sulphur and occluded gases can be eliminated by melting the metal, exposing it to the air and letting it thus absorb some oxygen, which then burns the sulphur and gas. The oxygen can then be removed by adding one of the above-mentioned deoxidizers. The important use of phosphorus in bronze is therefore to remove oxygen and also indirectly to destroy occluded gas and sulphur.

At the C., B. and Q. R R. brass foundry, at Aurora, Ill., we make a bronze with an extra high percentage of phosphorus, namely, 6 per cent. We make this alloy so as to have phosphorus in convenient form for use, and the process of manufacture followed by us is as follows: 90 lb. of copper are melted under charcoal in a No. 70 crucible, which holds about 200 lb. of metal when full; 11 lb. of tin are added and the metal is allowed to become hot. The crucible is then removed from the furnace and 7 lb. of phosphorus are introduced in the following manner: A three-gallon stone jar, half full of dilute solution of blue vitriol, is weighed. Then the weights are increased 7 lb., and phosphorus in sticks about 4 in. long is added till the scales balance again. The phosphorus is left in this solution half an hour or longer, the phosphorus being given a coating of copper, so that it may be dried and exposed to the air without igniting. We have ready a pan about 30 in. square and 6 in. deep, containing about 2 in. of water. Over the water is a wire netting, which is laid loose on ledges or supports along the inner sides of the pan. On the netting is blotting paper, and on this the phosphorus is laid to dry when taken out of the blue vitriol solution. The pan also has a lid which can be put down in case of ignition of the phosphorus.

We now have the phosphorus ready for introduction into the metal. This is done by means of a cup-shaped instrument called a retort or phosphorizer. One man holds the retort on the rim of the crucible in a horizontal position. A second man takes about three pieces of phosphorus and throws them into the retort. The first man then immediately plunges the mouth of the retort below the surface of the metal before the phosphorus has a chance to fall or flow out. Of course the phosphorus immediately melts and also begins to volatilize. As the phosphorus comes in contact with the metal, it combines with it. This process is continued till all the 7 lb. of phosphorus has been put into the metal. The metal is then poured into slabs about 3 in. by 4 in. by 1 in. thick. The metal is so hard that a greater thickness would make it difficult to break it up. When finished, the metal contains, by analysis, 6 per cent. of phosphorus. When we wish ordinarily to add phosphorus to metal, we do it by adding a little of this hardener.

Copper is a soft, ductile metal, with its melting point at about 2,000 degrees Fah., or 1,100 degrees Cen. Molten copper has the marked property of absorbing various gases. It is for this reason that it is so difficult to make sound castings of clear copper. Molten copper combines readily with the oxygen of the air, forming oxide of copper, which dissolves in the copper and mixes homogeneously with it.

A casting made from such metal would be very spongy. The bad effect of oxygen is intended to be overcome by adding zinc to the extent of 1 per cent. or more. This result can be much more effectively attained by the use of aluminum, manganese or phosphorus. The action of these substances is to combine with the oxygen, and as the product formed separates and goes to the surface, the metal is left in a sound condition. Aluminum and manganese deoxidize copper and bronze very effectively, and the oxide formed goes to the surface as a scum. When a casting is made from such metal, the oxide or scum, instead of freeing itself from the casting perfectly, generally remains in the top part of the casting mixed with the metal, as a fractured surface will show. Phosphorus deoxidizes copper, and the oxide formed leaves the metal in the form of a gas, so that a casting made from such metal shows a clean fracture throughout, although the metal is not as dense as when aluminum or manganese is used.

Copper also has the property of absorbing or occluding carbon monoxide. But the carbonic oxide thus absorbed is in a different condition from the oxygen absorbed. When oxygen is absorbed by copper, the oxygen combines chemically with the copper and loses its own identity as a gas. But when coal gas is absorbed by the copper, it keeps its own physical identity and simply exists in the copper in a state of solution. All natural waters, such as lake water, river water, spring water, etc., contain air in solution or occlusion. When such water is cooled and frozen, just at the time of changing from the liquid to the solid state, the dissolved gas separates and forms air bubbles, which remain entangled in the ice. The carbonic oxide which is dissolved or occluded in copper acts in exactly the same way.

Hydrogen acts in exactly the same manner as carbonic oxide. Sulphur also has a bad effect on copper and bronze. Sulphur combines with copper and other metals, forming sulphide of copper, etc. When molten copper or bronze containing sulphur comes in contact with air it absorbs some oxygen, and this in turn combines with the sulphur present, forming sulphur dioxide, which is a gas which remains occluded in the metal.

Tin is a soft white metal, melting at 440 degrees Fah., or 230 degrees Cen. Toward gases it acts something like copper, but not in so marked a degree. Although copper and tin are both soft, yet when mixed they make a harder metal. When bronze cools from the molten state, the copper and the copper tin alloy tend to crystallize by themselves. The quicker the cooling occurs the less separation will there be, and also the fracture will be more homogeneous in appearance.

Gun bronze contains copper and tin in the proportion of 9 or 10 parts of copper to 1 of tin. This is the metal used where an ordinary bronze casting is wanted. A harder bronze is copper and tin in the ratio of 6 to 1. This is often used as a bearing metal. When either of these metals is to be turned in the machine shop, they should contain about 3 per cent. of lead, which will make them work very much better, but it also decreases their tensile strength. Bearing metal now generally contains about 10 per cent. of lead, with copper and tin in varying ratios. The large percentage of lead is put in that the metal may wear away slower. Lead, although a metal having properties similar to tin, acts entirely different toward copper. Copper and tin have a good deal of affinity for each other, but copper and lead show no attraction at all for each other. Copper and tin mix in all proportions, but copper and lead mix only to a very limited extent. About 3 per cent. of lead can be mixed with copper. With bronze about 15 per cent. to 20 per cent. of lead can be mixed. In bearing bronze the lead keeps its own physical properties, so that the constituent lead melts long before the metal attains a red heat. It sometimes happens when a bearing runs warm that the lead actually sweats out and forms pimples on the metal. Or sometimes in re-melting a bearing bronze casting the lead may be seen to drop out while the metal is warming up. All of these metals, however, should contain something to flux or deoxidize them, such as zinc, manganese, aluminum, silicon, antimony or phosphorus.

The phosphor bronze bearing metal in vogue at Aurora has the following composition: Copper, 79·7 per cent.; tin, 10 per cent.; lead, 10 per cent.; and phosphorus, 0·3 per cent.

Melt 140 lb. of copper in a No. 70 pot, covering with charcoal. When copper is all melted, add 17½ lb. of tin to 17½ lb. of lead, and allow the metal to become sufficiently warm, but not any hotter than is needed. Then add 10 lb. of "hardener" (made as previously described) and stir well. Remove from furnace, skim off the charcoal, cool the metal with gates to as low a temperature as is consistent with getting a good casting, stir well again, and pour. The moulds for this kind of work are faced with plumbago.

There are several firms that make phosphor bronze bearings with a composition similar to the above one, and most of them, or perhaps all, make it by melting the metals and then charging with phosphorus to the extent of 0·7 to 1·0 per cent. But I have found some metal from all brands that I have tried that contains occluded gas. So that after such metal is cast, in about two minutes or so, the metal will ooze or sweat out through the gate, and such a casting will be found to be porous. But I have not yet had one such experience with metal made as I have described above. My explanation for the imperfections of metal made by adding phosphorus direct to the final mixture containing occluded gas would be this: The phosphorus as it is charged into the metal still contains a little moisture, and at the high temperature of the molten metal the phosphorus takes the oxygen from this water, leaving the hydrogen to be absorbed by the metal.

But this practical point should be heeded, viz., that pig phosphor bronze should be brought to the specifications that the metal should have shrunk in the ingot mould in cooling, as shown by the concave surface of the upper side, and that it should make a casting in a sand mould without rising in the gate after being poured.

In bearing metal, occluded gas is very objectionable, because the gas, in trying to free itself, shoves the very hard copper tin compound (which has a low melting point and remains liquid after the copper has begun to set) into spots, and thus causes hard spots in the metal.

Phosphorus is very dangerous to handle, and there is great risk from fire with it, so that many would not care to handle the phosphorus itself. But phosphor copper containing 5 per cent. of phosphorus, and phosphor tin containing 2 to 7 per cent. of phosphorus, and several other such alloys can be obtained in the market. I would suggest to those who wish to make phosphor bronze, but do not want to handle phosphorus itself, to make it by using the proper amount of one of these high phosphorus alloys. In using phosphorus it is only necessary to use enough to thoroughly deoxidize the metal, say 0·3 per cent. More than this will make the metal harder, but not any sounder.

In the course of the discussion Mr. Wickhorst stated that phosphor bronze shrinks very little. He expressed the belief that the pure copper castings used in electrical work are made with the aid of silicon copper.

* A paper read before the Western Foundrymen's Association, Chicago, March 17, 1897.

THE FIRST ENGLISH ARMOR PLATE ROLLING.

In a sketch of the life work of Sir John Brown, the eminent English iron and steel manufacturer, The Engineer gives the following account of the first armor plate rolling in England:

"It is Mr. Brown's custom to go on the Continent every autumn. In 1860, on his way home, he returned by Toulon. There was no little commotion in the place that day. The French ship La Gloire had put into the harbor. This ship was a wooden 90 gun three decker. The French had cut her down into a sort of magnified corvette, armed her with forty heavy guns, and clothed her with hammered iron armor 4½ inches thick; the plates were each five feet long and two feet wide. This 'new departure' in men-of-war put our admiralty in a fever. Ten 90 gun and 100 gun timber built ships were at once stopped in their construction, the intention being to make them so many British editions of the French craft. Sir John tried to get on board the ship. He was not allowed. Inspecting the vessel very closely through his glasses, his quick eye detected that the hammered armor had a cobbled look, rough, like a rubble wall. He felt sure he could do better than that. Convinced that he could roll a plate superior to anything that could be hammered, he went back to Sheffield and set to work. He put down a rolling mill, and experimented incessantly until he achieved his purpose. At a meeting of the Institution of Mechanical Engineers, Sir John read a paper, in which he gave a description of the method of rolling a five ton armor plate. As the first authoritative account of armor plate rolling in England, an extract is worth preserving. Here it is: Several bars of iron were rolled twelve inches broad by one inch thick and were cut thirty inches long. Five of these bars were piled and rolled down to another slab, and these two slabs were then welded and rolled down to a plate 1½ inches thick, which was sheared to four feet square. Four plates like that one were then piled and rolled down to one plate, measuring eight by four feet and two inches thick. Lastly, four of these were piled and rolled to form the final and entire plate. There were thus welded together sixteen thicknesses of plate, each of which was originally one inch thick, to form one plate 4½ inches thick, being a reduction of thirty five times in thickness, and in the operation from 3500 to 4000 square feet of surface had to be perfectly welded by the process of rolling. Even with the greatest care it was not surprising that blisters and imperfect welding should occur and render the plate defective. This was the chief difficulty to be overcome, and it increased with the magnitude and weight of the plate, the final operation of welding the four plates, measuring eight by four feet and 2¼ inches thick, being a very critical one. The intensity of the heat thrown off was almost unendurable, and the loss of a few moments in the conveyance of the pile from the furnace to the rolls would be fatal to success."

The Chicago Trade Bulletin says: "From present indications the United States will raise the largest yield of wheat in many years, and probably the finest crop harvested by any country in 1897. The yield, while liberal, will probably fall below the quantity reported in 1891, but the outlook now favors the second largest yield ever reported. The winter wheat crop is virtually out of danger, and the spring wheat crop, with a backward and unfavorable start, owing to unseasonable weather, is now reaching maturity in good condition, though it will not be out of danger of the changeable weather of the Northwest for four or five weeks. It is virtually safe, unless some damage should occur, to calculate that the aggregate yield will approximate about 550,000,000 bushels, about 310,000,000 bushels of winter and 240,000,000 bushels of spring. At the same time, it is doubtful if the Department of Agriculture will reach such conclusions. The grain trade is confident that the area reported by the Department of Agriculture is too small, possibly by 2,000,000 acres, and this is the weak feature in the returns to the department. The deficiency is largely in the new sections of the country which have been opened up through the agencies of railroads and the land disposed of to emigrants. These people, as a rule, are indifferent about making reports, and have a dread of a crop reporter, regarding him as an agent of the assessor in disguise."

ENGINEERING NOTES.

In some of the American car shops the journals for car axles are now turned up by means of a tool extending the whole length of the journal and accurately ground to the proper shape. The cut is thus several inches wide.

It is interesting to note that the capital value of the British Navy at the present time exceeds 94,000,000 pounds. The first cost of the fleet which led to the downfall of Napoleon was but 10 millions sterling. The fleet then comprised between 480 and 490 fighting vessels.

There are now in operation in the United Kingdom 380 blast furnaces, as compared with 372 at the beginning of the year, says Engineering. Of the total 95 are in the northeast of England, 179 more in other parts of England, 81 in Scotland, and 23 in Wales. There are, however, 682 furnaces actually built, so that 302 are not in blast. At the beginning of the year there were 313 idle. Five new furnaces are being built and five are being rebuilt.

Some interesting data have been collected by Mr. F. P. Sheldon, of Providence, R. I., intended to show the actual cost of steam power in New England and New York cotton mills. The results are based on actual yearly accounts, not on tests or calculations, and the cost per horse power per year of 307 days, of ten hours each, is found to be less than the common estimation. Compound condensing engines were used, and the highest running expenses—that is, fuel, labor, supplies, and repairs, also including fixed charges—show a total yearly cost per horse power of $14.80, and the lowest running expenses and fixed charges $11.64. In the highest cases given, fuel cost is stated as amounting to $3 a gross ton; in the lowest, mixed dust and slack costing $1.76 a gross ton was burned.

Mr. Thomas Fletcher, says Engineering, has recently published an estimate of the amount of coal gas needed to maintain an ordinary small fire clay muffle at the proper temperature for various purposes, and using the gas in atmospheric burners. For hardening steel cutters, etc., which requires clear red heat, about 8 cu. ft. of gas per hour are needed for every 10 sq. in. of floor area of the muffle. A yellow such as needed in silver assay work requires a consumption of 10 cu. ft. of gas per hour, while the bright yellow used in gold assays requires about 11 cu. ft. per hour. For still higher temperatures, such as needed in china, enamels, etc., the consumption may go up to 14 cu. ft. of gas per hour for every 10 sq. in. of the floor area of the muffle. Where metal muffles can be used, or the gas can be burned under pressure, a smaller consumption is needed.

The copper production of the world for 1896 is thus given in Le Génie Civil:

Country.	Metric tons.
United States	203,893
Spain and Portugal	53,375
Chile	23,500
Japan	21,000
Germany	20,063
Mexico	11,150
Australia	11,000
South Africa	7,450
Other countries	21,825
Totals	373,208

In 1888 the total copper production was 258,038 tons; in 1890 it was 310,472; 1893, 303,534; 1894, 324,505; and in 1895 it was 334,285 metric tons.

A model macadam road is being built at New Brunswick, N. J., by the road bureau of the United States Agricultural Department. Through the efforts of Prof. E. B. Voorhees, of the New Jersey Experimental Station, at New Brunswick, two government experts have been sent to supervise the construction and to bring with them the most approved machinery. The street treated is College Avenue, in the residential part of the city. The trap rock is crushed upon the ground, spread by an improved distributing wagon and laid to a depth of 4 inches. It is then rolled by a heavy steam roller and treated with a covering of cinders and a final coat of screenings. When this is completed, a 600 foot length of "farmers' cheap macadam" road is to be built. This road will be 8 feet wide and 5 inches deep. Road engineers and freeholders from various parts of New Jersey are closely watching the methods of construction.

Burning corn for fuel has often been mentioned by political orators as one of the signs that the poor farmer who burns it is in the last ditch of poverty, but a bulletin issued by the Experiment Station of the University of Nebraska, giving results of tests of the value of corn as fuel, shows that the burning of corn may be a proceeding showing financial wisdom and one greatly to the farmer's benefit when the price of corn is low and that of coal high. The tests showed that 1 lb. of screened Wyoming coal, costing $6.65 per ton, evaporated 1·9 times as much water in a steam boiler as could be evaporated by 1 lb. of a good grade of yellow dent corn on the ear, not thoroughly dry. The following figures show the value of corn per bushel as fuel when coal of the same variety as that used in the tests is selling at the prices given:

Coal per ton	$4.87	$5.41	$5.95	$6.49	$7.03	$7.57	$8.11
Corn per bushel	9	10	11	12	13	14	15

The calorific value of bagasse has recently been determined at the Ohio State University, and we are indebted, says the Engineering News, to Prof. W. T. Magruder, professor of mechanical engineering in that institution, for the following results of tests. Bagasse is the ground sugar cane, which is used by the sugar mills as fuel under steam boilers. The samples came from the Glenwild Sugar Factory, Berwick, La., and the tests were made with the Mahler calorimeter by Mr. Frank Haas, of the chemical department of the university. The moisture found in two samples, after drying to constant weight, was 44·13 and 44·38 per cent., average 44·26 per cent. The heating value of the dry bagasse, in three tests, was 4,542, 4,541 and 4,476 calories, or an average of 4,520 calories per lb., or 8,136 British thermal units per lb. This is equivalent to 4,535 B. T. U. for the moist bagasse containing 44·26 per cent. moisture.

ELECTRICAL NOTES.

Three interesting papers on transmission of power were recently read before the British Institution of Civil Engineers. Preece states that if coal costs only $1.25 per ton for transportation 100 miles, this is less than the interest on the capital required for construction of plant to transmit electrically, but other advantages of electric transmission are pointed out. Ellington writes on hydraulic transmission, and claims an efficiency of 75 per cent. over an area of 4 square miles, served from one pumping station, admitting, however, that this efficiency may drop to 50 per cent., depending on the application of the power. The third paper, by Hopkinson, refers to five methods of power transmission. He decides on compressed air as best for tunnel work, but recognizes the advantages of electricity in its flexibility. He also gives a prominent place to hydraulic transmission.

A new design of multiphase generator has been recently developed by the engineers of the General Electric Company, says the Engineering News, which is notable for the simplicity of its construction. This dynamo is a three-phase alternator with rotating fields and stationary armature, a design which so greatly facilitates the security of high insulation upon the armature that the dynamo can generate currents with pressures up to 5,000 volts. The machine is thus admirably adapted for long distance power transmission, as it dispenses with the necessity for step-up transformers in the power station. The rotating field has a substantial spider supporting a soft steel yoke ring magnetized by removable coils constructed to permit free ventilation. Current at low voltage is supplied to this field by two collector rings mounted upon the shaft. The armature coils are wound on forms and afterward placed about the poles, and thus a large portion of the coils remain exposed for ventilation. While these alternators have excellent inherent or self-regulating properties, they are sometimes compounded to insure accurate automatic regulation. Large generators of this type will be installed in the great Lachine Rapids plant, in the new Brooklyn Edison station, and in London, for the Central London Underground Railway.

Recent occurrences in Europe have brought out very clearly the growing use of electricity in warfare, says the Electrical Engineer. Naval experts at Kiel have been testing the practical uses of dragon-shaped airships or balloons, which may be put on board vessels for use during naval engagements and in reconnoitering. Some of the balloons rose 5,500 ft., remaining fastened to the decks of torpedo boats, which were steaming 18 knots an hour, enabling the balloonists to make valuable observations of the stations of vessels at a great distance. The observations made were communicated by telegraph or telephone from the balloons to persons on the decks of the vessels below, enabling them to change the course of the latter accordingly. At the British jubilee naval review the United States man-of-war Brooklyn received great attention; and Mr. Laird Clowes, the naval expert, declared that, as proved by the new ship, England is in the resort to electricity many years behind the United States. That she will remain so is seriously open to question, but credit for our leadership is welcome and must be ascribed to the patient and brilliant work of such men as Lieut. B. A. Fiske, who may be said to be devoting their lives to this subject, in behalf of our navy.

The Electrical Review does not regard vestibuled trolley cars with favor, and urges some practical objections to their employment. Commenting on the law passed by our last Legislature making it obligatory on all surface railroad corporations operating street cars in cities of less than 50,000 to run vestibule cars in the inclement winter months, it says: "If we are to judge by results elsewhere, the wisdom of such a law is doubtful, and its operation a useless expense to the railway companies. The glass front of the vestibule is the objection, for two reasons: It gets covered with frost, rain or snow or moisture, and becomes a serious obstruction to clear vision on the part of the motorman. It acts at night, besides, as a mirror, reflecting back the light thrown out from the car. So serious is this that in many cases the management has been compelled to hang a curtain across the car door so as to keep the vestibule dark, but it is a doubtful remedy. The general result of a vestibule law has been, we believe, to increase the number of accidents. If the law were amended to be something in line with the marine regulations compelling pilots to keep at least one window open to the air, most of the objectionable features would be eliminated and a higher degree of safety assured."

Long distance transmission has received quite a substantial impetus by the signing of a contract between the Southern California Power Company and the General Electric Company for an 80 mile electrical transmission equipment, says the Engineering News. This is really a remarkable step, and shows clearly that modern electrical machinery is reaching a very high degree of refinement. Previous to this the Ogden-Salt Lake City plant, in which power is transmitted a distance of 36 miles, held the record. The new California plant will be over three times as long, will transmit four times the power and will have a line pressure three times as great as the present Niagara Falls and Buffalo transmission plant. The power station will be located twelve miles from Redlands and will utilize the river running through the Santa Ana Canyon. The present plan is to draw water from this river at its junction with Bear Creek and convey it by means of suitable canals, tunnels and flumes along the canyon sides to a point where the riveted steel pipe line will begin. This will have a vertical fall of 750 ft. in its length of 2,200 ft. Four impact wheels will drive four General Electric three-phase generators, each of 750 kw. output, to which they will be directly connected. 250 kw. step-up transformers will raise the pressure to 33,000 volts. This unusually high line voltage is considered advisable owing to the very great length of the transmission. It will necessitate especial care in general insulation and line construction, but can be safely handled with present apparatus. Prof. E. M. Boggs, of the Arizona University, has been engaged as chief engineer for the Power Company.

SELECTED FORMULÆ.

Ink Eraser.—The following formulæ will be found effective and uninjurious to the paper if carefully handled:

Citric acid	1	part.
Water, distilled	10	"
Concentrated solution of borax	2	"

Dissolve the citric acid in the water and add the borax. Apply with a delicate camel's hair pencil, removing any excess of water with a blotter. A mixture of oxalic, citric and tartaric acids in equal parts, dissolved in just enough water to give a clean solution, acts energetically on most inks.—Canadian Druggist.

Dressing for Linoleum.—A weak solution of beeswax in spirits of turpentine has been recommended for brightening the appearance of linoleum. Here are some other formulas:

(1.) Palm oil	1	ounce.
Paraffin	18	"
Kerosene	4	"

Melt the paraffin and oil, remove from the fire and incorporate the kerosene.

Polish.

(2.) Yellow wax	1	ounce.
Carnauba wax	2	"
Oil turpentine	10	"
Benzine	10	"

Melt the waxes carefully, add the oil and benzine, and stir until cold.

(3.) Yellow wax	5	ounces.
Oil turpentine	11	"
Amber varnish	5	"

Melt the wax, add the oil, and then the varnish. Apply with a rag.—Pharmaceutical Era.

Perspirol.—For excessive perspiration of hands and feet:

Prepared Venetian talc	20	ounces.
Powdered orris root	10	"
Oxide of zinc	5	"
Powdered tartaric acid	5	"
Powdered boric acid	5	"
Salicylic acid	2½	"
Menthol	¼	"
Oil of eucalyptus	¼	"

Make a fine powder, to be applied to the hands and feet, or to be sprinkled inside the gloves or stockings.—Chemist and Druggist.

Compound Menthol Cones.—The following formula is given by Schimmel as representing a form of compound menthol cone which now finds widespread use:

Menthol, crystallized	1	part.
Chloral hydrate	1	"
Cacao butter	2	"
Spermaceti	4	"

The best way to prepare the cones is to melt the spermaceti and the cacao butter; dissolve the other ingredients in the melted mixture, and then pour the whole into chilled moulds.

Starch Glaze (Powder).—

Gum arabic, powdered	3	parts.
Spermaceti wax	6	"
Borax, powdered	4	"
White corn starch	8	"

Method of Preparation.—All these bodies are to be intimately mixed in the powder form by sifting through a sieve several times. As the wax is in a solid form and does not readily become reduced to powder by pounding in a mortar, the best method of reducing it to such a condition is to put the wax into a bottle with some sulphuric or rectified ether and then allow the fluid to evaporate. After it has dissolved the wax, as the evaporation proceeds, the wax will be deposited again in the solid form, but in fine thin flakes, which will easily break down to a powder form when rubbed up with the other ingredients in a cold mortar. Pack in paper or in cardboard boxes. To use, four teaspoonfuls per pound of dry starch is to be added to all dry starch, and then the starch made in the usual way as boiled starch.—Canadian Druggist.

Photographic Hints and Formulas.—

From Liesegang's Photographischer Almanach.—(Amer. Photo. Jl.)

Dr. Andresen's Eikonogen Formulas.—

(1) One solution:

Sulphite of soda (crystals)	4	parts.
Carbonate of potash	2	"
Eikonogen	1	"
Distilled boiling water	40	"

This mixture, while still warm, should be put into bottles, which must be well corked. It will then keep in good condition for an indefinite time, provided pure boiling water and a good quality of sulphite of soda have been used. Should the developer prove too strong, it may be diluted with a sufficient quantity of water; for the production of especially delicate negatives the quantity of carbonate of potash should be reduced by one half. In case of over-exposure, start developing with a fresh weak solution, to which a few drops of a solution of bromide of potassium have been added; or better still, develop with a solution that has already been used. To develop bromide prints, the developer should be diluted with five parts of water.

(2) Separate Solutions:

(a) Sulphite of soda (crystals)	4	parts.
Water	60	"

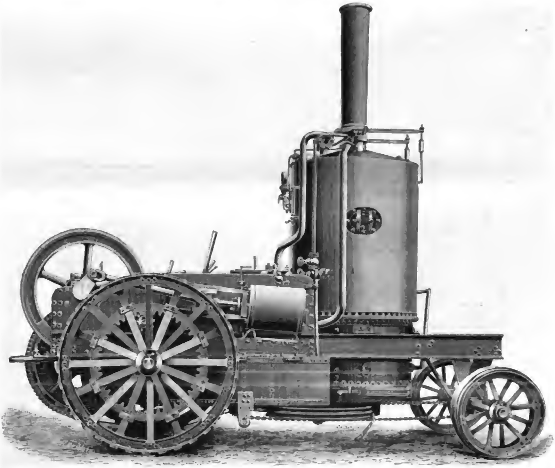
To this add one part of eikonogen, and shake till dissolved.

(b) Carbonate of soda (crystals)	8	parts.
Water	20	"

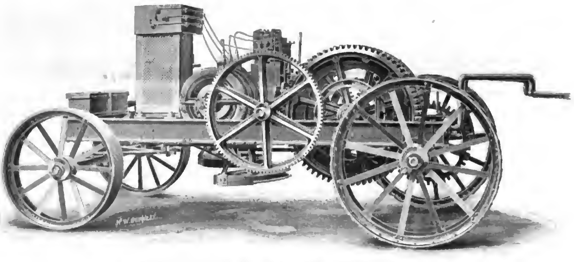
For use, mix three parts of (a) with one part of (b).

Fixing Bath.—Plates which have been developed with eikonogen should be well washed, and can be advantageously fixed in an acidulated fixing bath. To obtain this, dissolve one part of fixing salt in eight parts of water or dissolve five parts of sulphite of soda (crystals) in one hundred parts of water, acidulate with one part of concentrated sulphuric acid, and then add twenty parts of hyposulphite of soda. The bath remains clear even after frequent usage, it hardens the gelatine, and yields negatives of a very fine printing color.

ELECTRICALLY DRIVEN PLOWING TACKLE.



STEAM TRACTION ENGINE FOR PLOWING.



ELECTRICALLY DRIVEN MOTOR FOR AGRICULTURAL USE.

FROM time to time during the last ten years and more we have heard rumors of steam and horses being supplanted in plowing by electricity, but the affairs have usually been only experimental and have led to no permanent results. Lately, however, the system has been worked out in Germany on a commercial basis, and we are now able to lay before our readers illustrations of machines constructed by Mr. A. Borsig, of Berlin, and now being used in many localities. Electric plowing tackle is best adapted to meet the requirement of the great beetroot estates in Germany, which are devoted to the manufacture of sugar, for they are of large extent, and have command of capital to enable them to adopt all labor saving appliances. Further, there are, on such estates, large installations of steam power, which lie idle a great part of the year, including the period at which plowing is done. Hence, by the addition of dynamos, and of a system of overhead conductors in the fields, it is possible, at small cost, to adopt electric plowing over a large area.

The overhead conductors do not extend into all the fields, but are tapped by temporary wires laid on the ground, as required.

In cases in which electric power is not available, Mr. Borsig plows by steam, employing an engine of the form shown in the engraving. It will be seen that it is fitted with a vertical boiler, the firebox of which is furnished with a number of diagonal tubes to increase the heating surface. The boiler barrel can be removed bodily when it is desired to scale the firebox. The engine is self-propelling, and can be used to haul the other appliances to and from the fields. Its arrangement of rope drums is similar to that of the motor wagon we are about to describe.

The motor wagon carries two drums on horizontal axes. On these the two ends of the rope are wound, the bight passing round the sheave on the anchor wagon. One drum is driven to draw in the rope, while the other runs under a brake, to keep the tail rope fairly taut. The two parts of the rope are led round guiding sheaves, revolving in horizontal planes, under the wagon. The two rear wheels can be connected to the motor by clutches and gearing to propel the wagon, while the two leading wheels serve to steer it. On the opposite side of the wagon to that shown in the view there is a platform for the attendant, with the various handles and levers grouped in front of it. The weight of a motor wagon is 7 tons.

Mr. Borsig states that with fixed steam engines of 250 horse power, and with five plows, 6000 acres of medium heavy ground can be plowed to a depth of 14 in. at a cost of 3s. 10d. per acre. If separate engines have to be employed, the cost per acre is increased by 7d. per acre.

The anchor wagon shown in the other cuts carries a sheave round which the plowing rope runs. The sheave is fixed in a guide, and is connected by a chain to the anchor. Hence as the anchor sinks into the earth under the pull of the rope, the sheave and it move together. The anchor itself has four prongs, and is hung from a light crane, or derrick, by which it can be completely raised for traveling, if the jib be wound up by the worm hoist at the opposite side of the frame. At other times it is manipulated by the chains running round the pulleys at the head of the jib. The slack end of the plowing rope, when the plow is moving toward the motor wagon, actuates gearing which winds the anchor out of the ground and moves the anchor wagon forward into the right position for the next double set of furrows. At the same time the anchor and sheave are moved backward relatively to the frame to allow for the slip of the anchor in the earth. The anchor is then dropped by the attendant and the next set of furrows cut. The strain of the rope goes direct from the pulley to the anchor, and not through the wagon frame. We are indebted to London Engineering for the cuts and description.

BLEACHING WAX AND STEARINE.

By S. RAMBOK.

IN bleaching beeswax it is usual to expose the crude material in the form of rather thin, round cakes to the action of the sun, and this way the wax does not lose or hardly lose any of the specific aroma which is one of its much sought for qualities. (Chem. Zeit.) As to the consistency and hardness of wax thus bleached, it is equal to that of the raw material. Unhappily, this process has several faults. The chief of these is the long time which the operation takes, and this is a matter which affects the economy of the process to a large extent. Attempts have been made to abridge the time exacted by bleaching operations, but, unhappily, results have not responded to the hopes of the inventors of the methods proposed.

The process which has furnished so far the best results is that which consists in augmenting artificially the richness of the air in ozone. Practice shows us, in fact, that the bleaching rooms for wax situated in the country in the proximity of pine forests operate with much more efficacy than those which are by their situation placed in atmosphere less saturated with ozone. The artificial distribution of ozone is done by finely spraying spirits of turpentine or just lately by galvanic measures. Unfortunately, an effective abbreviation of the period of bleaching is only obtained in this manner when the wax has been melted to begin with in the presence of a certain quality of humidity. If this condition is not filled, the ozone produced, whatever may be the quality of it, has no action on the wax. The proposed is to look for some method of modifying to the best advantage the natural process of bleaching. Having arrived at this conclusion, the author has undertaken a series of experiments on the best manner of carrying the natural method out, and has arrived at the following conclusions:

1. The Proportion of Water in Wax.—Wax entirely dry exacts double the length of time for its bleaching as that which contains from 2 to 5 per cent. of water. If, therefore, an energetic ventilation is arranged, by means of which it is possible to pass moist air over the cakes of wax, a slight humidity will help the operation very greatly, especially if the cakes are not too thick.

2. Saturation with Humid Air.—When the air is saturated by steam vapor, four times as much time is required to arrive at an identical result, even when the other conditions are most favorable.

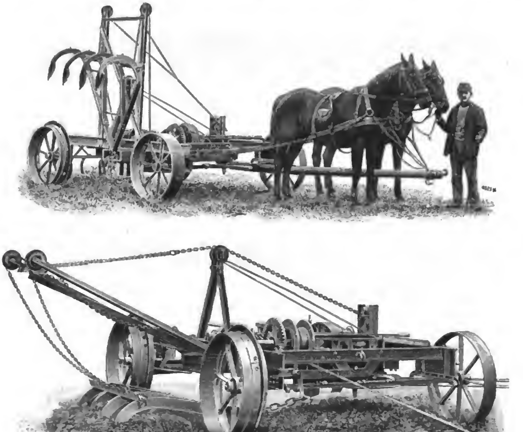
3. Surface Exposed.—All other conditions being equal, the time of bleaching is in direct relation with the amount of surface exposed. It is, therefore, of the highest importance to expose to the action of the air and sun as much surface as possible.

4. Temperatures.—If the wax containing 3 per cent. of water and in slices as thin as possible is exposed in a refrigerator at a little under freezing point to the direct rays of the sun, no traces of bleaching are noticed for a long time. If, on the other hand, the wax is exposed to the direct sunlight at a temperature of about 75 F., bleaching takes place very rapidly (about 70° F. is sufficient for the commercial operation).

5. The Sun.—As we have seen in the preceding paragraph, the action of light is almost nil at low temperatures. According to the personal experience of the author, diffused daylight seems to have rather more energetic action than that of the direct rays of the sun, all other conditions of temperature, air, etc., being equal.

A bleach of surprising rapidity is got with the Laval "Emulsor." If the virgin wax is melted and made into an emulsion with water at from 75° to 100° C., and if after stopping the emulsionizing apparatus the mass obtained is thrown into cold water, the result is to get a quantity of globules of wax of extreme tenuity, which in favorable weather are bleached at the end of two or three days. If the wax is melted, to begin with, with a third of its weight of wax already bleached, the operation does not take more than forty-eight hours. As the apparatus gives a considerable yield (220 gallons of emulsion per hour), the process may be considered as a very practicable one from a commercial point of view. With the aid of this apparatus, which is capable of giving the matter to be bleached a very extended surface, we believe that natural bleaching can enter into serious competition with the chemical bleaching, at least so far as the saving of time is concerned. And if, on the other hand, the fact that the natural properties of the wax are preserved by natural bleaching is taken into account, we do not doubt that this new process will be universally adopted. The high prices actually obtainable, and the more and more frequent adulterations of the product, will give an extraordinary value to a process which will leave the wax the natural and characteristic signs of purity.

With the same emulsionizing apparatus the chemical bleaching can be done in ten minutes as follows: The crude material is emulsionized in slightly alkaline water and brought up to 175° F., then after having been treated with hypochlorite of sodium and



THE ANCHOR WAGONS, SHOWING ANCHORS RAISED AND LOWERED.

production of the ozone by turpentine is alway perfect, for the simple reason that the peculiar aroma of the wax is better preserved in this way.

But although the period of bleaching seems to be sensibly shortened by the aid of ozone, nevertheless entire weeks are needed, and if the weather is unfavorable even entire months, to bleach the wax in satisfactory fashion. A number of processes of bleaching by the aid of drugs have been tried and practiced industrially with the object of arriving more rapidly at the end proposed, but unhappily none of them is capable of destroying the coloring matter alone without harming some of the other properties of the material. At the same time that color disappears the chemical products employed destroy the special aroma of the wax, which, of course, is very similar to that of honey. Moreover, methods of energetic oxidation have influence on the consistency of the wax, which they render brittle. Therefore, although bleaching by chemical means hardly needs more than twenty-four hours, and gives an absolutely white product, the process has not been generalized. In the few factories where it is adopted, from 5 to 10 per cent. of matter naturally colored and aromatized is added to the bleached wax to recover as nearly as possible the tone and the perfume of the original product. Still the product thus treated changes color and loses its perfume at the end of a few days. The essence of wax prepared by Schimmel & Co. has also been tried, but the results have not given satisfaction. The product aromatized by its means loses its perfume rapidly, and ends by giving out a disagreeable odor of gasoline. It follows, therefore, from what we have said, that the only way of reaching the end

If we put these observations into practice, a white wax with the odor of honey will be obtained in a relatively short time. This aroma will not disappear after years of storing if the product is storked in closed vessels and kept in an obscure place. In addition to the greater surface to be given to the matter to be bleached, great care should be taken not to work except in ventilated rooms provided with heating apparatus which can be regulated at will, so as to give the needed heat to the air in humid and cold weather.

If the wax which has been bleached is melted with virgin wax, the bleaching of this latter seems to take place more rapidly; thus, for example, if two pounds of crude wax are melted with one pound of bleached material, only half the time will be needed to bleach this mixture that would be taken in bleaching three pounds of crude wax. We can say, therefore, that the bleached material bears in itself the power of bleaching, and this fact is in direct parallel with the other fact already noted, that a very considerable time is needed before the action of bleaching begins to show itself on the surface of the raw material, and that, on the other hand, as soon as the surface begins to show the bleach, the effect produced transmits itself very rapidly through the whole of the mass.

If the wax is melted and poured on thin plates of iron and exposed thus to the bleaching agents, this also contributes to accelerate the action of bleaching.

allowed to rest for ten minutes, hydrochloric acid is added until an acid reaction is obtained. The mass is then emulsionized anew in warm water to get rid of the acid which adheres to the particles, and a white wax is then obtained with very fine grain and free from ash. Its only fault is that it lacks aroma. The same satisfactory results are got with Japan and Carnauba waxes.

Finally, we may note that the fatty acids for stearine making, whether got by distillation or expression, behave like animal wax in the presence of bleaching agents, and it is also possible to accelerate the bleaching of these products in the same way. The well known and frequent difficulties of manufacture, when the candles remain for entire weeks without changing in the bleaching room, without a plausible reason for the phenomenon being apparent, arise without doubt from the insufficient state of hydration of the stearine, or from a too low temperature, or from the surrounding air giving off too much humidity. If, therefore, stearine already bleached is melted with crude stearine and emulsionized in lukewarm water, so that the mixture can be thrown into cold water with or without the addition of a little oil of turpentine, a very white and beautiful stearine will be obtained in a few days even under bad conditions of climate. The stearine becomes very hygrometric by emulsion. The fusion eliminates the water, and it is only a very small proportion that the stearine retains in purely mechanical mixture. From this moment the bleaching takes place very rapidly. The candles moulded out of the stearine dry thoroughly during the bleaching and burn in a normal manner.—Pharmaceutical Era.

ON CHICLE GUM.

By Edward N. Butt.

When at Campeche, in Southern Mexico, a few weeks ago, in addition to logwood, mahogany, hides and other miscellaneous cargo, we shipped from thirty to thirty-five tons of chicle gum. At Progreso, in Yucatan, our next port of call, another twenty-five tons of chicle gum was added to the cargo. From subsequent inquiries I found that the gum in question was produced by the Achras sapota, a tree which grows wild in the forests in the state of Yucatan and the immediately adjoining states of Central America. It is indigenous from Mexico to Guiana, and cultivated in all tropical countries.

In the states of Campeche and Yucatan the Peons, as the lower class of natives of Aztec descent are called, search the forests where these trees grow, and, having selected those which are sufficiently mature, make V-shaped incisions in the stem. The juice which exudes from the incision soon becomes indurated by exposure to the scorching heat of the sun and is subsequently collected. Fresh V-shaped incisions are made in the same trees from time to time for a period of two or three years and the indurated gum collected. The trees are then allowed to rest for four or five years, after which period they are again fit to undergo the tapping process and yield fresh supplies of gum. When a sufficient quantity of the crude gum has been collected it is pressed into thick oblong blocks, which weigh from twenty-five to thirty kilos each. The collector then usually carries the gum to the stores of the merchants, either suspended from his head or packed on burros, as the Mexicans call that patient animal the donkey. The exporting merchant usually packs three of these blocks in a bale, the average weight of each bale being eighty kilos. In the year 1895 no less than four million pounds weight of chicle gum, of the estimated value of one and a half million dollars gold, was imported into New York from Mexico. I inquired for what purposes this large quantity of gum was used, and found it was the basis or chief ingredient used in the manufacture of "chewing gum," a substance practically unknown in this country, but almost universally used in the United States by men, women and the young of both sexes, many of the male population having adopted it as a harmless substitute for tobacco. The habit of chewing "chewing gum" is said not only to increase the flow of saliva, but to relieve indigestion and dyspepsia. This may possibly be the case with those samples which contain pepsin, especially as the once prevalent habit of spitting is rapidly on the decline, partly due to the substitution of gum for tobacco for chewing purposes, but mainly in consequence of the affixing of notices in all the street cars of most of the cities in the Eastern States prohibiting spitting therein, signed "By order of the Board of Health."

When I had obtained the above information respecting chicle gum, I determined to make further inquiries and obtain as much information as I could about the manufacture of "chewing gum" during the short time I was in New York.

A quarter of a century ago there were practically only two kinds of "chewing gum" in use in the United State, viz., the regularly prepared spruce gum and shoemaker's wax. A little later a mixture of paraffin wax with either resin, balsam of tolu or some other ingredient of a similar character was put on the market. This new variety of chewing gum rapidly became a favorite with the ladies and also with the youngsters, who called it "Coal oil gum." Preparations called "Taffy tolu" and "Snapping wax" were next introduced for similar use. These preparations acted as the pioneers for the enormous trade which has sprung up in "chicle chewing gum." Its present use was discovered by an accident. Some twelve or fourteen years ago a lot of this Mexican gum was sent to New York on board ship partly as ballast and partly in the hope that it would be found suitable for use by bookbinders or possibly in the leather trade. After several trials it was found to be quite useless for any known purpose, and failing to find a purchaser, it was decided to tow it out to sea and throw it overboard in order to get rid of it. Just at that time one man out of the hundreds who were standing at the wharf casually picked up a piece of the gum, examined it and found it would "chew." The idea at once occurred to him that it would form a suitable basis for making a new kind of chewing gum, and without difficulty he succeeded in obtaining the whole lot for the trouble of shoveling it out of the ship. That man was a Mr. Adams, the head of the firm of Messrs. Adams, Sons & Company.

Mr. Adams' first venture in making chewing gum was cooked in a tea kettle and worked up on the kitchen table. Now, the gum as taken from the bales is first chopped into small pieces and then boiled in water. Wood, pieces of bark and all other impurities which are light separate from the gum, float on the surface and are skimmed off, while those which are heavy, such as dirt, stones, etc., fall to the bottom. When the gum is perfectly clean and all the foreign substances have been got rid of, it is removed to a mill where it is ground up, the mill making about three thousand five hundred revolutions a minute. The ground gum is then subjected to a continuous heat of 110° F. in drying rooms. When the gum is sufficiently dry, it is sent to the cooks, who put it into large steam jacketed pans and add to it pure white sugar, granulated pepsin, powdered kola or other desired ingredients. It is then turned and mixed by an ingenious double acting rotating paddle until it has assumed the consistency of bread dough. The "dough boys" then take it in hand and add to it the flavoring ingredients, such as oil of peppermint, oil of wintergreen, etc., and while still warm thoroughly work and knead it until it looks like gingerbread, finely powdered sugar being added from time to time during the kneading process to prevent its sticking. It is then allowed to cool and afterward passed through steel rollers until reduced to the proper thickness, when it is removed to the markers, steel-knived rollers which partly cut through the long sheets of gum. Next it is removed to the seasoning room, and finally broken up into pieces of suitable size on the lines left by the markers. The finished gum then goes to the wrapping room, where the nimble fingers of one hundred and fifty to two hundred young ladies wrap it in waxed paper, tinfoil and pretty wrappers, and thence to the packers, who pack it in jars or boxes ready for sale to the numerous dealers.

RECIPES FOR MAKING CHEWING GUM.

Should any one in this country be desirous of embarking in the manufacture of this article, I append a few formulæ which I have taken from Merck's Market Report, but the different varieties and various flavors now on the market may be numbered by hundreds. Those varieties, however, of which chicle gum is the basis, are those which are most in favor at the present time in the United States:

1. Balsam tolu	4	parts.
Benzoin	1	"
White wax	1	"
Paraffin	1	"
Powdered sugar	1	"

Melt together, mix well and roll into sticks of the usual dimensions.

2. Balsam tolu	4	parts.
Resin, white	10	"
Paraffin	3	"
Powdered sugar	Sufficient.	

Melt the balsam, resin and paraffin together, and, while still fluid, incorporate sufficient sugar to make a suitable mass. Roll out with powdered sugar and cut into pieces.

3. Balsam tolu	3	parts.
Powdered sugar	1	"
Oatmeal	3	"

Soften the gum on a water bath and mix the ingredients; then roll in powdered sugar and cut into sticks.

4. Venice turpentine	40	parts.
Common turpentine	80	"
Yellow wax	20	"
Balsam tolu	4	"
Balsam Peru	2	"

Melt together and add in fine powder—

Cinnamon	12	parts.
Chocolate	30	"
Red sandalwood	4	"
Sugar	2	"
Myrrh	2	"
Galangal	2	"
Ginger	2	"
Cardamom	1	"

Mix, and, when sufficiently cool, roll out into sticks or any other desirable form.

5. Gum chicle	3½	pounds.
Paraffin wax	1	"
Balsam tolu	2	ounces.
Balsam Peru	1	"

Dissolve the gum in as much hot water as it will take up, melt the paraffin and mix all together, then take—

Sugar	10	pounds.
Glucose	4	"
Water	3	pints.

Dissolve the sugar and glucose in the water, boil the solution up to the "crack" degree, pour the sirup upon an oil slab, turn into it sufficient of the above gum mixture to make it tough and plastic, incorporate the flavor (powdered cinnamon, chocolate, sandalwood, myrrh, ginger or cardamom), and when sufficiently cool roll into sheets or sticks.

As there is "so much money" in chewing gum, some one may be desirous of going into the trade, but before starting to manufacture he must make sure of a continuous supply of the raw material. At the present time the whole of the export trade in gum from Mexico is in the hands of a very few persons, and the importers and manufacturers in the United States are also very few in number, less than half a dozen, I believe, who not only hold contracts with the exporters, but also refuse to sell the raw material.—Pharmaceutical Journal.

WORLD'S TEXTILE PRODUCTION.

In Kuhlow's, published at Berlin, we find the following:

"The production of raw material for the manufacture of textile fabrics has increased very much during the past forty years.

"In 1850 the quantity of wool grown in Europe, the United States, La Plata, the Cape and Australia amounted to 805,000,000 pounds; in 1870 to 1,371,000,000 pounds; in 1880 to 1,577,000,000 pounds; and in 1895, according to the 'Annual Report of the President of Permanent Commission on Customs Valuation,' to 2,334,000,000 pounds, or nearly three times as much as that available for manufacture in 1850, 70 per cent. more than in 1870, and 45 per cent. more than in 1880.

"The increase in the quantity of cotton available for commerce, and which increase goes on from year to year, has also been marked. It is estimated that the amount yielded by the United States, India, Egypt and other countries was 695,000,000 pounds in 1830, 1,192,000,000 in 1840, 2,391,000,000 in 1860, and 4,000,000,000 in 1880. According to the report of the president of the valuation commission, the world's cotton crop in 1895 was 18,200,000 bales of 400 pounds, or about 7,280,000,000 pounds. This is eleven times more than in 1830, six times more than in 1840, three times more than in 1860, and 80 per cent. more than in 1880. The above mentioned report states 'the consumption cannot keep pace with the production,' but if the retail price should fall, many consumers would become large purchasers. The report adds that 'spinners never had such an opportunity of stocking at a low price, but that the year was less advantageous to the weavers than to the spinners.' Of the 18,200,000 bales produced in 1895, 10,500,000 bales (those of 450 pounds) were from the United States, 2,600,000 bales (of 400 pounds) from India, and 634,000 bales (of 717 pounds, or nearly two ordinary bales) from Egypt. In the United States alone the area of land cultivated with cotton amounts to upward of 20,000,000 acres.

"The report of the valuation commission deals, in the third place, with silk. In 1895 the quantity of raw silk produced and put on the market was 35,000,000 pounds; in 1894, 30,250,000 pounds; and in 1893, 33,000,000 pounds. Europe and Asia Minor supplied from 35 to 38 per cent. of the whole, the far East from 64 to 65 per cent., but China is still the chief exporting nation for this raw material, having sent out in 1895 13,500,000 pounds. Japan is progressing rapidly; she produces already as much silk as all the European countries together, and is continually increasing her mulberry plantations. Although the yield increased in 1895, there was also a very evident rise in prices. For some time silk manufacturers have been making great progress in the United States, and the establishments of that country, according to the report, are in the first rank as regards the amount of silk worked up, viz., 9,372,0.0 pounds, as against 8,008,000 pounds in France, 5,610,000 pounds in Germany, 3,652,000 pounds in Switzerland, and 5,610,000 pounds in Russia.

"With regard to flax, hemp and other materials, the report does not state the amount of production at the disposal of the industries of the world, owing doubtless to the difficulty of obtaining information on this point. The production of flax in France has not ceased to decline, in spite of the very high bounties granted, and the area of land cultivated with flax in that country does not exceed 89,000 acres."

CAN THE HAIR TURN WHITE FROM FRIGHT?

The man whose hair has "turned white in a single night" from fear or under strong emotion used to figure extensively in stories and popular tradition. The possibility of his existence has been denied by some, but cases of the kind are too well authenticated to be thrown aside. A contributor to Cosmos (Paris, February 27) details some recent investigations that have been made on the subject, and gives us a physiological explanation of the process, says the Literary Digest.

"Toward the age of forty years, sometimes a little earlier, the hair begins to turn gray. This grayness appears at first in the region of the temples, where threads of silver mingle with the hairs and their number increases day by day; the head turns gray and then whitens. It is a phenomenon of vital regression, common to mammals, and to many animal species. Brown-Sequard has studied its mechanism. The hair turns gray progressively and slowly, but the isolated whitening of a single hair is generally rapid and may take place in one night. This observation of the celebrated physiologist gives some credit to the stories of rapid and even sudden whitening of the hair, told by divers authors. If normally a single hair can whiten in a few hours, it is not difficult to explain that in certain determinate cases the thing can take place with a lock of hair, or even the whole head.

"M. Fere has cited an instance of this in Le Progrès medical (January 23, 1897) and has referred us to the facts published in his well known work on 'The Pathology of the Emotions' (Paris, 1892).

"His memoir has given several authors the opportunity to recall their own observations on the subject, and we shall cite a few cases that seem to bear the stamp of authenticity.

"Dr. Parry, in the Dublin Medical Press, May 8, 1861, gives the following instance:

"'On February 19, 1859, the command of General Franks, operating in the southern part of the kingdom of Oude, had an engagement near the village of Chamba with a body of rebels; several of the enemy were taken prisoners; one of them, a Sepoy of the Bengal army, aged about fifty-four years, was led before the authorities to be questioned. I then had occasion, says Parry, to observe in this man, at the very moment when they took place, the events that I propose to relate:

"'The prisoner seemed for the first time to be conscious of his danger when, deprived of his uniform and completely nude, he saw himself surrounded by soldiers. He then began to tremble violently, terror and despair were depicted on his face, and, though he responded to the questions addressed to him, he seemed actually stupefied by fear. Then, under our very eyes and in the space of scarcely a half hour, his hair, which we had seen was a brilliant black, turned gray uniformly over his whole head. A sergeant who had made him prisoner cried out, "He is turning gray," and so called our attention to this singular phenomenon, which we, as well as many others, were then able to follow in all its phases. The discoloration of the hair took place gradually, but it became complete and general in the short space of time already mentioned.'

"With this so precise observation we may compare the assertion of Bichat, who saw one of his friends grow quite white in the space of a single night, after having experienced a violent emotion.

"The unfortunate Queen Marie Antoinette grew almost entirely gray during the night preceding her execution.

"Moleschott relates that Louis Sforza grew entirely white in the night following his defeat and capture, after his campaign against Louis XII.

"A Dutch physician, Junius, tells of a nobleman of high rank who, being condemned to be beheaded, grew gray in one night.

"The same thing happened to the Seigneur de St. Vallier, father of Diana of Poitiers, while Guarini, professor of Greek at Verona, grew gray all at once on learning of the loss at sea of a chest of manuscripts that was coming from Constantinople.

"Thompson cites the case of a workman at York, who, having fallen from a high building that he was repairing, succeeded in holding on to the gutter with one hand. He was rescued, but not until his hair had turned white

"The cases in which the change of color is not instantaneous, but is very rapid, appear to be most frequent. Bichat relates several. . . .

"Emotional grayness seems to be favored by pressure; when after the shock the subject remains during some time with his head resting on his hand or his arm, the compressed part is often the only one affected, or at least is particularly affected. A case of this kind was related several years ago to M. Fere by one of his patients whose father was a physician. . . . Young O——, then aged five years, was in a carriage with his mother when the horse ran away. He was greatly frightened, but suffered no physical injury. Two days afterward he had an eruption all over his body, without fever; . . . eight days after the accident it was seen that the child had, on the hair of the right side of his head, five white spots, whose position and form corresponded to

the prints of five fingers, and the mother remembered that she had held her hand on the head of her child in this position in endeavoring to protect him. The change of color of the hair was permanent, the spots even increased in size; at present (ten years later) the largest, which is the nearest to the forehead and corresponds to the position of the thumb, has nearly the size of a two franc piece."

After citing several more curious and well authenticated cases of the kind, including some in which grayness was brought on by an apoplectic stroke, the author concludes as follows:

"This grayness following an apoplectic stroke is analogous to the cases that have an emotional cause. These last are not absolutely unheard of among animals. Thus Thompson tells, according to Young, of a blackbird which had been surprised in its cage by a cat, and which, when it was rescued, was found lying on its back and covered with sweat; its feathers fell off and grew in perfectly white. A gray linnet was once seized in its cage by a drunken man who tore its feathers off, the little creature lived, but its feathers grew in again white.

"When the hair whitens, the phenomena that takes place are easily understood, and they have been made a special study by Pincus. The quantity of air contained normally in the hair cavity increases, and at the same time there disappears or diminishes a pigmented oil that is secreted by the hair follicles, and that gives to each hair its characteristic color. It is well known what influence the nervous system has on the secretions and, in general, on the sebaceous glands; it would be surprising if those of the hair should escape this influence, and so the sudden whitening of the hair, whose possibility has sometimes been denied, is explained from the physiologist's point of view."—Translated for the Literary Digest.

CARE OF THE EARS.

The ears are not often treated of, even in popular manuals of hygiene, probably because it is not thought that much can be done by the owner of the ears to modify or in any way improve them, says the Independent. You go to an aurist, he takes his watch in hand and proceeds to test your hearing, and he talks about "necessary hearing," "superfluous hearing," "good hearing," "normal hearing," etc., while the patient can hardly be made to believe there can be such a thing as superfluous hearing. A few years ago an eminent aurist tested the hearing of twenty-five patients of an eye and ear hospital, who never had suspected that their hearing was not perfect—only five of them proved to have perfect hearing, i. e., that which could be called normal; but the twenty whose hearing could not come up to the "normal" standard had never imagined that there was any deficiency, and so this class of persons are classified as being possessed of "necessary hearing," and they have all that is needed to enable them to perform the ordinary duties of life.

It is surprising how many of the persons who consult the aurist are relieved by simply having a mechanical obstruction removed; either an accumulation of wax or a wad of cotton that has been put in at some long forgotten time when the patient had an attack of earache. When there is an accumulation of wax it usually follows measles or scarlet fever and is easily removed by dropping a little sweet oil in the ear, allowing it to remain till the wax is softened and then syringing the ear, preferably with a douche from a fountain syringe; but if a person is out of range of this excellent appliance, a very good substitute can be improvised by filling a quart bottle with warm water (as hot as can be borne) and attaching a sufficient length of rubber tubing to its mouth, inverting it and allowing the water to flow through the tubing to the ear. In the case of impacted cotton wads the course of action is generally this: The person takes cold, the membranes of the ear become swollen and sensitive in sympathy with the throat, but the patient has his attention fastened on the ear, and to protect it he inserts the cotton. In a few days the inflamed membranes of his nose and throat become normal, the sensitiveness of the ear is forgotten and the cotton remains; but the man says: "In fact, I've never heard well since I had that terrible cold five years ago." It is simply a mechanical obstruction that he is suffering from.

An experienced aurist raises the note of warning against the use of ear spoons, ear sponges, etc., that are to be found in any druggist's shop. He denounces them as worse than useless—as often the active agents of irreparable harm. He says there is more wisdom than humor in the old adage "Put nothing in your ear but your elbow." The end of the little finger wrapped in a handkerchief is allowable, but nothing else.

The deafness from accumulated wax is generally sudden, and is accompanied by a dull, rumbling sound, and it should at once be carefully looked at and treated by a competent observer.

We have been hearing a great deal lately about "preventable blindness," and it is a matter of devout thankfulness that the thousands of blind infants that have swelled the ranks of the dependent classes will now be saved by the immediate Crede treatment—especially in those States which have enacted laws to punish the ignorant neglect of unintelligent nurses and midwives, who do not realize that while they are pottering with tea leaf dressings a hopeless curtain of opacity is spreading over the cornea, while the proper application of nitrate of silver would arrest the mischief. The attendants at our eye infirmaries say it is most pitiful to see the mothers of children three and four weeks old, who bring the children with cornea gone, and are told that the time to save the sight was before the child was seven days old.

Now as to "preventable deafness"—for the aurist tells you that most of the deafness which robs people of much of their "necessary hearing" is not primarily dependent on the ear at all—the real cause is to be found in a swollen and inflamed condition of mucous membrane that lines the upper portion of the nostrils and the back part of the throat; and of course the point to which efforts to improve the hearing should be directed is the membrane lining the nostrils and throat. The man who tested the defective ears—Dr. A. M. Fanning—deprecates the snuffing up of salt or salt water from the hand as is often done, and recommends instead a solution of common baking soda (bicarbonate of soda) both as a gargle for acute sore throat and as a wash for the interior of the nose itself. He says: "It is a great mistake forcibly to snuff it into the nostrils from the palm of the hand, as is commonly done. . . . The best and simplest way to use the soda solution is to bury the nose entirely in the cup of fluid, and then gently suck the solution into the nose, at the same time holding the mouth widely open. There is no risk of choking if the mouth is open and the head thrown forward, for all the fluid will run out at the mouth. Careful attention to the general health, all judicious measures of exercise, a diet that will insure sound blood—counteracting inflammatory tendencies—and, above all, care to avoid taking cold, is the true 'treatment.'"

TETANUS ANTITOXIN.*

One by one the diseases which have hitherto defied the skill of physicians are yielding to the persistent attack of modern science. Since the successful treatment of diphtheria by subcutaneous injections of antitoxic serum was demonstrated—hardly three years ago—it has been confidently predicted that sooner or later all diseases which result from the action of a poison secreted in the blood by a special and characteristic bacillus would be conquered by similar means.

From the evidence now presented, it would appear that tetanus, one of the most sinister and stubborn of human maladies, if not already conquered, is in a fair way to be successfully overcome. In the Deutsche Medicinische Wochenschrift (Berlin) for October 23 appears a joint announcement by Prof. Dr. Von Behring, of diphtheria antitoxin fame, and Prof. Knorr, of Marburg, describing the qualities and best methods of using the new tetanus antitoxin, which is now prepared under government supervision as a commercial product by the Farbwerke at Hoechst-on-Main, and offered for use by medical practitioners under the same conditions as diphtheria antitoxin from the same source.

Tetanus, as is well known, is an exceedingly painful and hitherto usually fatal disease caused by blood poisoning, generally the result of a wound. It is believed by physicians to be caused by the introduction into the system of a minute organism which rises from the ground in certain localities, so that the prevalence of tetanus varies greatly even in different districts of the same country. At all events, the disease has its characteristic microbe, which has been recognized, isolated, described and reproduced by artificial culture. The distinctive symptom of tetanus is a persistent spasm of the voluntary muscles, aggravated by light, noise or other disturbing influence to which the patient may be subjected. These spasms may affect any muscular portion of the body, but when, as is often the case, the maxillary muscles are principally attacked, the resulting malady is known as lockjaw.

The tetanus antitoxin described by Prof. Behring and Dr. Knorr is similar in nature, action and in the methods of its preparation to the antitoxin of diphtheria. It is prepared and put up for use in two forms, viz., as a dry powder, which is used for the treatment of developed cases of tetanus in men and animals, and as a liquid solution, which is employed for prophylactic purposes. Its strength or degree of efficiency is measured, like that of antidiphtheritic serum, by antitoxic units. The dry antitoxin is designated as a hundredfold normal antitoxin—that is, 1 gramme of the preparation contains 100 units of antitoxic power; in other words, is sufficient to neutralize 100 grammes of the normal poison of tetanus. It is put up for commerce in vials containing 5 grammes each, and the contents of one such vial are theoretically sufficient for the cure of a developed case of tetanus. It is dissolved in 50 cubic centimeters of sterilized water at a temperature of 40° C. and injected hypodermically at a single dose. In the treatment of horses, the injection is made into a vein, by which the full action of the antitoxin is accelerated by about twenty four hours, and this method of injection may even be employed with human patients in very severe cases or where the treatment is commenced at a late and perilous stage of the disease. To insure favorable results, the injection should be made, if possible, within thirty-six hours after the presence of tetanus is definitely indicated. The liquid solution is protected from contamination by germs in the atmosphere by a small admixture of phenol. The dry preparation, on the other hand, requires no such antiseptic while in that form, but when dissolved in water it becomes subject to deterioration, which may be prevented by the addition of one per cent. of chloroform.

The tetanus solution is of fivefold strength, that is, 1 gramme of the liquid contains five antitoxic units, and in this form it is put up in sealed 5 gramme vials. In presence of wounds which give reason to fear lockjaw or other form of tetanus, a small subcutaneous injection of the solution is made, the quantity used being proportionate to the condition of the patient and the time that has elapsed since the injury was received. In all cases the wound should be antiseptically treated, so as to prevent as far as possible the further generation of poison in the blood.

Tetanus is a disease of seldom occurrence in this section of Germany, and opportunities to test the remedy in actual practice are comparatively rare. One such case has been recently treated at the hospital of the Holy Spirit, in Frankfort, the record of which is officially and minutely given.

On September 19 last a coppersmith (L. M.) twenty-five years of age and resident in Frankfort experienced, after exposure to thorough wetting, severe pains and stiffness in the muscles of the neck and throat. Two days after the first symptoms appeared he came under treatment by a physician, who kept the patient in bed and administered chloral and salicylate of soda. The symptoms of tetanus continued to develop, and on the night of September 29 became so marked and violent that on the following day the patient was transferred to the hospital. A careful examination revealed a small cut or scratch under the right ear, then nearly healed, and so slight in outward appearance that it had passed almost unnoticed. At the time of admission to the hospital the patient was growing rapidly worse. The chin was twisted far to the left, the head drawn backward and immovable and the muscles of the body, especially the back and abdomen, were hard and tensely drawn. The patient was isolated in a dark room and treated with subcutaneous injections of morphine, which gave no relief. The slightest noise or disturbance, such as the entrance of the physician or nurse into the darkened room, induced severe spasms, and the condition of the sufferer continued to grow steadily worse. At 4 o'clock in the afternoon of October 1 a prolonged spasm of intense severity left no further doubt of a fully developed case of tetanus, and half an hour later 5 grammes of the hundred unit antitoxin, dissolved in 50 grammes of water, were injected hypodermically at three places on the breast.

During the evening of the same day a slight but definite improvement was observed, and this continued throughout the following day, the spasms being fewer and of shorter duration than before the antitoxin had been administered. This condition was maintained from October 3 to 6, when the acute symptoms gradually returned, and by 9 o'clock in the evening became so severe that a second dose of 4 grammes of normal antitoxin was administered as before, with the result that before the next morning the muscles began to relax, the spasms became lighter and less frequent and from that time improvement was so rapid and sustained that on October 23, sixteen days after the second injection of antitoxin, the patient was convalescent, and, at his own request, was discharged from the hospital.

This, in the opinion of the physicians in charge, was a typical and conclusive case, in which life could not have been saved by any other treatment previously known, and in which the course of the disease might unquestionably have been arrested and greatly shortened had the antitoxin been used when the patient first came under medical treatment, instead of ten days later, when the case had become one of acute and fully developed tetanus.

It is, of course, too soon to estimate the exact prophylactic or therapeutic value of the new remedy. That can only be determined by a long series of observations in actual practice, which will be made as rapidly as the comparative rarity of the disease itself will permit. Thus far the antitoxin has been used experimentally, both in this country and in France, with horses, cattle, guinea pigs, mice, etc., and from these tests and the hospital case above described the indications are that its use entails no injurious result. The antitoxin is prepared with extreme care, subjected to rigid inspection and control at the imperial testing laboratory at Steglitz, and with this guarantee is placed within reach of bacteriologists and medical practitioners in all countries.

FRANK H. MASON,
Frankfort, November 16, 1896. Consul-General.

* U. S. Consular Reports.

THE POISON OF SUNSTROKE.

Dr. Ira Van Giesen, director of the State Pathological Institute, at Madison Avenue and Twenty-third Street, contributes an interesting tentative review of the investigation and experiments into the nature of sunstroke made in this city during the heated term last summer to the State Hospital Bulletin, recently issued. The experiments attracted widespread attention at the time, since they involved the study of sunstroke from the standpoint of physiological chemistry, from which aspect the disease had previously received but little attention from the medical world.

Dr. Van Giesen believes that the investigations have established the auto-toxic nature of the disease. He considers it remarkable that sunstroke has not received more attention from that standpoint, because of the tendency of many authorities to place diseases in the category of auto-intoxications when they have comparatively insecure proofs.

He describes sunstroke as "a brilliant example of an acute, intense, and virulent poison originating within the body, acting rapidly and violently upon the nervous system." He became convinced that the acute degeneration of the cortical cells was due to the action of a poison, and the outbreak of the affection in this city afforded excellent opportunities to substantiate, if possible, that theory. The results obtained from experiments showing the effects of the body fluids and excretions of living cases of sunstroke upon animals are described in detail.

Repeated injections of urine in rabbits from several different cases showed uniform hypotoxicity shortly after the sunstroke occurred. Injection of the cerebro-spinal fluid and ventricular fluids taken from the brain of fatal cases showed lethal results in some animals. These experiments, however, are not considered to have much significance, since the animals died when not under observation, some hours after the injection.

Prompt and decisive results were obtained from injections of blood serum taken from patients during the period of what is known as hyperpyrexia. These experiments were noteworthy and are described at much length. Although Dr. Van Giesen has noted fatal results in some such cases which could not be attributed to the injection of the material, he believes that there "was no mistaking the cause of death which occurred so uniformly in these animals in succession. This result is in consonance with the hypothesis that the rapidly fatal course in severe cases of sunstroke is due to an intense, rapidly acting poison, circulating in the body fluids. If this view be correct, it was to be expected, as was in fact the case, that even the small quantity of blood serum used in the rabbits would produce experimentally this rapid, prompt and fatal effect."

Other experiments involving the injection of urine from convalescing patients into the blood circulation of rabbits were also attended by interesting results. Dr. Van Giesen thinks that "it is not too much to say that the virulence of the auto-toxic poison in some cases of sunstroke is fully as rapid and violent as snake venom, and considerably resembles its action. Cases of sunstroke which entered the hospitals with purple, swollen faces, rapid and very much enfeebled heart action, and profound collapse, with death occurring within one to two hours, are surely examples of the effects of the most violent poisons that we know of. Such a poison seems immediately to act upon the ganglion cells which govern the heart and which manage the vasomotor apparatus. This brings about such a rapid suspension of the most vital functions that the body hardly has a chance, so to speak, to react against or eliminate the poisons."

Switzerland's National Council has voted unanimously to make insurance against accident and sickness compulsory on all citizens.

SPITZBERGEN.

Our readers may have wondered how it is that we are kept so well informed about the proceedings at remote Dane's Island (near Spitzbergen), the starting point of Andree's north polar expedition. But Spitzbergen, however far from civilized domains, is not by any means without all culture.

Within the last twelve months it has been brought into close union with the European continent by the opening of a Norwegian steamship line from Hammerfest to Advent Bay. This latter port lies on the western coast of Spitzbergen, on one of the finest and largest fiords of the island. For some years there has of course been a considerable amount of traveling to and from Spitzbergen, but the opening of the steamer line has given the island a place among the innumerable places accessible by regular service accommodations. Besides, the company has built a hotel, where the travelers may settle down in comfort, or at any rate find shelter at any time. Norway has provided Advent Bay with a post office, so that little far north settlement now stands in direct union with the Continent, both as regards traveling and mail.

Hammerfest lies farthest north of all European towns. In spite of its seclusion from other townships, it has for some time been supplied with electric lighting.

The cause of this early development lies in the peculiar circumstances which place Hammerfest in unusually great need of good lighting; for two months in the year the sun sends not a ray of light on the town.

From Hammerfest then the boats run to Spitzbergen. Hammerfest itself must be reached by boat, not being in connection with any other Norwegian town by rail.

For centuries Spitzbergen has only been accessible to a few explorers, whalers, Arctic hunters, etc., but now it is open to all. The postal connection will no doubt do a great deal toward increasing the number of tourists visiting the island.

The late successes of Nansen in particular are strong motives with many for a journey to the Arctic regions. Spitzbergen is certainly the most appropriate of all northern territories for tourists. With its rich Arctic flora and fauna, and its glittering glaciers, it offers all the charms of a polar journey, while under the existing circumstances it is easily reached. In a little more than two days the traveler is taken from Hammerfest to Advent Bay; here he finds small steamers under the guidance of experienced captains, ready for occasional trips for seal hunting and Arctic sport.

In these seas there was once an abundance of whales, but whalers of all nations, especially Englishmen, Dutchmen, Hanseates, Baskes and Danes, played such havoc among those great sea mammals that at the beginning of this century their pitiless slaughter, begun soon after the discovery of the island in 1596, had exterminated the whales from those waters. Still the island was frequented, even after that, for its elks, bears, and other furred beasts, and mainly by Russians. At present the western and northern shores of Spitzbergen are struck by Norwegian sailors, to secure furs of the polar bear, to hunt the elks, the seals and eiders. These hunters have thrilling tales of adventure to tell, which must be taken with a grain of salt. Still the danger of a forced hibernation in those regions, with provisions calculated for a much shorter period, is by no means to be made light of. Sometimes masses of ice block the retreat from Spitzbergen in autumn, and the men have to wait till spring to return. In most cases no precautions are taken for such emergencies, and the adventurer who escapes with his life can consider himself fortunate. That a hibernation on Spitzbergen with the necessary provisions is not such a very serious matter is clearly shown by the example of the Russian Staratschin, who spent a large portion of his life on the island. At Green Harbor, a part distinguished by its striking beauty of nature, he spent thirty winters on the cape bearing his name, and of those thirty, fifteen in succession. He died there of old age. To the present day the name of this patriarch of Spitzbergen lives among the Arctic seafarers.

If a stay on Spitzbergen in the long polar night, in spite of the beautiful northern light, involves many discomforts, the summer is all the more charming.

In the vales and lowlands the sun's warm rays soon melt away the snow, and vast expanses of moss and lawn covered ground are soon gay with animal life. On the ice along the shore, too, blue and white foxes and other Arctic animals can be seen. Here the passionate hunter can enjoy such hunting as few other spots on the earth can afford. Polar bears are mostly seen in spring in the fiords, but occasionally one is sighted in summer too.

Under such circumstances it is not to be wondered at that the train of tourists to the island is steadily increasing, particularly now that the traveling accommodation and mail connection to Spitzbergen have received the great improvement which we mentioned at the beginning of our article.

It may be interesting to our readers to hear that the boat which takes you from Hammerfest to Spitzbergen is under command of Otto Sverdrup, the man who has become famous for his successful navigation of the Fram, the ship that bore Nansen and his company on their Arctic expedition.

HOTEL AND POST OFFICE, ADVENT BAY, SPITZBERGEN.

This information about the little island in the distant northern seas will, we hope, be welcome to our readers at a time when the newspapers have just announced the departure of Andree on his aerial journey poleward.

Our illustrations, which show several spots of special interest and beauty on Spitzbergen, are taken from Ueber Land und Meer.

BEES AS WEAPONS OF WAR.

History records two instances, according to Mr Whiteley Stokes in the London Athenæum, in which bees have been used in warfare as weapons against besieging forces. The first is related by Appian, of the siege of Themiscyra in Pontus, by Lucullus in his war against Mithridates. Turrets were brought up, mounds

CAPE THORDSEN, SPITZBERGEN.

were built, and huge mines were made by the Romans. The people of Thennseyra dug open these mines from above, and through the holes cast down upon the workmen bears and other wild animals, and hives or swarms of bees. The second instance is recorded in an Irish manuscript in the Bibliothèque Royale, at Brussels, and tells how the Danes and Norwegians attacked Chester, which was defended by the Saxons and some Gallic auxiliaries. The Danes were worsted by a stratagem; but the Norwegians, sheltered by hurdles, tried to pierce the walls of the town—when, "what the Saxons and the Gaedhil who were among them did was to throw down large rocks, by which they broke down the hurdles over their heads. What the others did to check this was to place large posts under the hurdles. What the Saxons did next was to put all the beer and water of the town into the caldrons of the town, to boil them and spill them down upon those who were under the hurdles, so that their skins were peeled off. The remedy which the Lochlans applied to this was to place hides outside on the hurdles. What the Saxons did next was to throw down all the beehives in the town upon the besiegers, which prevented them from moving their hands or legs from the number of bees which stung them. They afterward desisted and left the city."

New Hampshire, in 1770. There is little evidence of its again occurring in New England in great abundance until 1861, when it was very destructive, as it was also in 1875. The last serious and widespread outbreak in New England appears to have been that of 1880. The army worm is generally destructive in seasons following years of unusual drouth. It is seldom injurious in a given locality for two successive summers, but it is worth while to burn over—in autumn, winter, or spring—fields where it may be present.

The story of the life of the individual army worm may be briefly told. On some summer night there appears in the meadow a good sized light brown moth. Flying about, she finds a cluster of strong growing grass. Into the folded leaves of one or more of these she pushes a number of small whitish eggs, gluing them in rows of a dozen or more. A week or ten days later each egg hatches into a minute, whitish worm, that nibbles at the grass blades at night and in the daytime hides beneath the grass from the rays of the sweltering sun. It grows rapidly in size. At the end of a week it moults or casts its skin, a process in which the old skin splits open along the back, and the worm crawls out, clothed in a new skin that had developed beneath the old one. Again it feeds as before, its voracity increasing with its size. This moulting is repeated four or five times during the month after the worms hatch, so that by the end of this period the insect is an inch and a half long, and has the familiar markings of the full grown army worm.

The instinct of the worm now teaches it to seek more secure shelter for the helpless stage upon which it is about to enter. It burrows into the soil an inch or less and wriggles about in the earth until it produces a hollow cell. In this it casts its skin again and becomes a pupa—the third stage of its existence. When the worms are very abundant, many of them do not go into the ground, but change to pupæ beneath whatever shelter may be at hand. About a fortnight later, another change takes place, and the fully developed moth emerges from the pupa, thus completing the round of the insect's life. The moths fly toward dusk and at night, and by means of their long tongues, coiled up when not in use, they suck the nectar of various flowers. The moths sometimes seem attracted by buildings. I have been told of their swarming toward the close of cloudy afternoons about barns and outbuildings; and early in August, this year, they were trapped by thousands in the projecting porch of Thompson Hall. We killed one thousand of these moths, placed them in a little heap, and photographed them. The photograph is reproduced in Fig. 1. It represents the moths about one-half natural size, and seems a small pile, but had the moths not been killed there might have developed from them in September nearly half a million army worms.

During ordinary years the army worm is present in most of the regions where its outbreaks occur, individual worms feeding here and there in meadows and pasture lands, but the number is not sufficient to attract notice. At such times their habits of life are very similar to those of the common cutworms, to which, indeed, the army worms are closely related. It is only when these insects become so excessively numerous that they exhaust the food supply of the field in which they develop that the "army" habit is assumed. Then, however, they are forced to seek new quarters for food, and as their only mode of progress is by crawling along the ground, they move in solid masses toward adjacent fields. "Their numbers at these times," wrote Dr. C. V. Riley, "are often so enormous, and their voracity so great, that it is impossible for one who has not been an eye witness to appreciate it fully. . . . The army worm when traveling will scarcely turn aside for anything but water, and even shallow watercourses will not always check its progress, for the advance columns will often continue to rush headlong into the water until they have sufficiently choked it up with their dead and dying bodies to enable the rear guard to cross safely over. I have noticed that after crossing a bare field or bare road where they are subjected to the sun's rays, they would congregate in immense numbers under the first shade they reached. In one instance I recollect their collecting and covering the ground five or six deep all along the shady side of a fence for about a mile, while scarcely one was seen to cross on the sunny side of the same fence."

The army worm feeds by preference upon plants of the great grass family, which includes both the grasses and grains. The moths are especially attracted, for the deposit of their eggs, to rank growths of grasslike plants. To this is due the fact that in New Hampshire this year the brood of worms destructive in July was oftenest found in barley fields, while that destructive in September ravaged the fields of Hungarian grass. In feeding upon timothy and similar grasses the leaves are first stripped, and in cases of severe attacks the heads will be wholly or partially gnawed off; one such is represented in Fig. 7. They also feed freely upon the leaves and more or less upon the succulent stalks of wheat, oats, barley, rye, sorghum, and Indian corn. Generally they feed upon clover only when driven to it by hunger.

Apparently there were three broods of worms in New

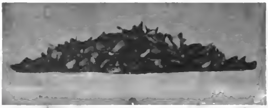


FIG. 1.—A Thousand Army Worm Moths.

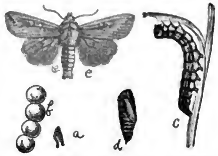


FIG. 4.—a, egg mass, natural size; b, eggs, magnified; c, full grown larva; d, pupa; e, moth. (After Riley.)

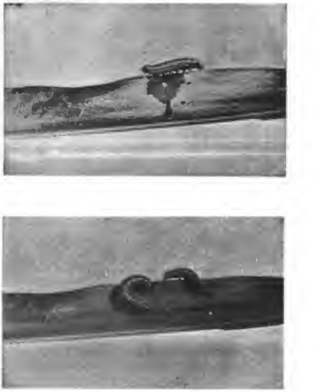

FIGS. 2 AND 3.—Photographs of Army Worms.


FIG. 5.—Moths of Army Worms, Natural Size.


FIG. 6.—Army Moths Entrapped in Spider's Web.

THE ARMY WORM—VARIOUS STAGES OF ITS DEVELOPMENT.

THE ARMY WORM.

By CLARENCE M. WEED, New Hampshire College Agricultural Experiment Station, September, 1896.

EARLY in July complaints began to reach the Experiment Station of the injuries inflicted by the army worm* upon grain and grass fields. Whenever specimens were submitted, they proved to be the true army worm. Serious injury, especially in barley fields, was done during July; and again in September, when another brood of worms had developed, especial damage was reported to be done in fields of Hungarian grass. As soon as the first outbreak was reported, I visited the infested fields, studying the worms at work, and bringing specimens to the station, where they were placed in breeding cages to determine their life histories. The results of these and subsequent studies, as well as a summary of our knowledge of the insect in general, are embodied in this bulletin.

The army worm is believed to have occurred in New England as long ago as 1743, a year when, according to early records, there appeared "millions of devouring worms in armies, threatening to cut off every green thing." The pest was also present in great numbers in New Hampshire, in 1770. (continued above)

* Leucania unipuncta.

Hampshire this season. Before the destructive brood that appeared in July there must have been a brood developed during late spring or early summer. Some members of this generation, and perhaps most, probably passed the winter as partially grown worms, while others may have wintered over in other stages of the insects' existence, for the broods are by no means definitely limited. In a given field at a given time one may find many sizes of worms. The worms injurious in July were doubtless the second generation for the season. The majority of these entered the pupa state during the middle or latter part of the month and emerged as moths early in August. The progeny of this brood of moths became full grown larvæ in September, changing to pupæ late in the month. It seems almost certain that many of the pupæ must go through the winter without changing to moths; and that many of the moths must hibernate without laying eggs.

The egg of the army worm moth is a tiny whitish sphere with a diameter of only about one-fiftieth of an inch. When first deposited it is dull and opaque, but soon afterward it becomes shiny and more or less irides-

FIG. 7.—Head of Timothy Grass Gnawed by Army Worms. (Original.)

cent. Just before hatching it appears much darker. The spherical outline in many specimens is changed by the sticky material attached to them at the time the eggs are deposited. Specimens, natural size and magnified, are represented in Fig. 4, a, b.

The larva when full grown is of the form represented in Figs. 2 and 4 c. It is a smooth, cutwormlike caterpillar, an inch and a half long, generally of a dark gray or dingy black color, "with three narrow yellowish stripes above and a broader one or slightly darker on each side, thinly clothed with short hairs (to be seen with a lens) which are longer and somewhat thicker on and about the head. The latter is of a polished honey yellow color, with a network of fine dark brown lines and a black line on the front like the letter V reversed." The size of the mature worms varies considerably, some specimens reaching a length of two inches.

The pupa into which the full grown army worm changes before it can become a moth is represented in Fig. 4 d. It is a quiet, footless, wingless object, of a bright mahogany brown color, and measures about three-fourths of an inch in length. At the smaller end

FIG. 8.—Black Ground Beetle. (After Riley.)

there are two pointed projections side by side, and near the base of each projection is a smaller, more slender spine with a hooked tip.

The adult moth into which the army worm develops, and from the eggs of which it originates, is represented, natural size, in Figs. 5 and 4 e. Its expanded wings measure about an inch and a half from tip to tip, although there is considerable variation in the size of different specimens. The general color of the body and front wings is a peculiar reddish gray, perhaps more distinctly described as fawn color. Near the middle of each front wing are two more or less irregular lighter patches, each of which on closer study is seen to be made up of three smaller spots. Along the side margins of both pairs of wings there is a fringe of feathery scales, immediately inside of which, on each of the front wings, is a row of blackish dots. The hind wings are more grayish, with less of the reddish tinge.

Fortunately for the American farmer, the army worm has a host of natural enemies, which generally keep it below the danger line. A large number of birds consider the worms excellent eating, and feed freely upon them. A list of such birds would include nearly all our native insectivorous species that search for food upon the ground, but special mention should be made of the robin, the blackbird, the bobolink and the meadow lark, which search grass lands for insect larvæ more persistently than many other of our common birds. These and other birds are very useful in keeping army worms and cutworms in check, and should be encouraged by every one.

But the birds are not the only enemies of the army worm. In the fields where the pest has been present this season there have also been found a great many large black beetles, some of them similar to the one represented in Fig. 8, and others somewhat larger.

There are also many species of internal parasites that prey upon the army worms. Among the most abundant of these are certain two winged flies that glue eggs upon the backs of the worms. The eggs hatch into tiny footless maggots, that enter the bodies of the worms when they hatch, and develop inside at the expense of their unwilling hosts. Finally they kill the worms and the maggots change to pupæ, from which they soon emerge as flies. These are called tachina flies. There are several species of four winged ichneumon flies that have a similar history, and are often very destructive to the hosts of army worms.

The larger ground spiders also feed freely upon these worms; and the moths are often entrapped in the webs of the spinning spiders (Fig. 6).

To the action of these various natural checks is doubtless due the seemingly strange appearance and disappearance of this vexatious pest. Nature strives ever to keep a balance in her affairs, and when an insect becomes too abundant, she marshals her various forces to bring it into subjection.

When an outbreak of army worms is first noticed, if it is confined to a limited area, it is generally well worth while to cut down the grass or grain infested. The worms will remain beneath its shelter for two or three days, and as soon as the cut grass or grain is dry enough it should be burned, thus destroying the pests and preventing the invasion of neighboring fields. The worms may also be destroyed by spraying them with strong kerosene emulsion. This is prepared by adding 2 gallons of kerosene to 1 gallon of a solution made by dissolving ½ pound of hard soap in 1 gallon of boiling water, and churning the mixture by forcing it back into the same vessel through a forcepump with a rather small nozzle, until the whole forms a creamy mass, which will thicken into a jellylike substance on cooling. The soap solution should be hot when the kerosene is added, but of course must not be near a fire. The emulsion thus made is to be diluted before using against the army worm with five or six parts of water to one part of emulsion. The amount of dilution varies with different insects. Soft water or rain water should be used in diluting. If this cannot be obtained, add a little lye or bicarbonate of soda. It should be applied with a spray pump or nozzle.

The device of stopping the armies of traveling worms by means of ditches and trenches occurred to the earliest sufferers from their depredations. In the New Hampshire outbreak of 1770, Mr. Powers tells us that the inhabitants "dug trenches around their fields a foot and a half deep, hoping this might prove a defense; but they soon filled the ditch, and the millions that were in the rear went over on the backs of their fellows in the trench and took possession of the interdicted food."

Some years ago Dr. C. V. Riley wrote: "From experiments which I have made, I am satisfied that where fence lumber can be easily obtained it may be used to advantage as a substitute for the ditch or trench by being secured on edge and then smeared with kerosene or coal tar (the latter being more particularly useful) along the upper edge. By means of laths and a few nails the boards may be so secured that they will slightly slope away from the field to be protected. Such a barrier will prove effectual where the worms are not too persistent or numerous. When they are excessively abundant, they will need to be watched and occasionally dosed with kerosene to prevent their piling up even with the top of the board and thus bridging the barrier. The lumber is not injured for other purposes subsequently."

One of the simplest ways of preventing injury by the army worm, where it can be done without danger to live stock, is that of dusting or spraying with poison a strip of grass or grain in advance of the invaders. The simplest way of doing this would be to apply Paris green when the dew is on in the morning by means of one of the insecticide bellows now upon the market, designed more especially for use against the potato beetle. We have used two patterns of these this season and found them to do excellent service. One of these, the standard Paris green duster, is shown diagrammatically in Fig. 9. It is an admirable machine, and will distribute a pound of Paris green evenly over an acre of potato vines. The other, called Leggett's insect powder gun, is shown in Fig. 10. It is a slightly larger machine, costing also a little more, but it does excellent work. With either of these machines the poison can be applied much more easily than by any other method.

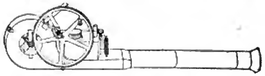


FIG. 9.—Standard Paris Green Duster. (Original.)

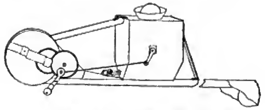


FIG. 10.—Leggett's Insect Powder Gun. (Original.)

ON THE RELATIVE VARIATION AND CORRELATION IN CIVILIZED AND UNCIVILIZED RACES.*

THE general conclusion would then be that, with increased civilization, absolute size and variation tend to increase, while correlation, to judge by the males, is stationary; to judge by the females, tends to increase.

It will be found somewhat difficult to reconcile these results with any simple applications of the principle of natural selection. In the first place increased variation undoubtedly suggests a lessening of the struggle for existence, and there can be no question that this increase has gone on among civilized races (see "Variation in Man and Woman"). The lessening of the struggle has probably been greater for woman than man; hence the principle of natural selection might help to explain the preponderance of variability in civilized woman. The increase in size with civilization seems, on the average, also incontestable. But is it the effect of lessening the struggle for existence? The possibilities may, perhaps, be summed up as follows:

(a) The civilized races may have survived owing to their superior size. It may be a result of the struggle in the past. To this must be objected that the increase of size appears to be a progressive change still going on, and yet increase of variation should show a lessening struggle for existence.

(b) The effect of suspending natural selection may be to increase size. This would be a blow for panmixia, for we might naturally have expected a regression to the smallness of the more primitive races. It would leave unexplained the apparently smaller progress of women as compared with men, for in their case we might argue from the variation that the struggle for existence is relatively less than in the case of man.

(c) The larger size of the civilized races may be due to better food supply and better physical training; in short, it may be due, not to evolution, but to better conditions of growth. This hypothesis does not involve the assumption that acquired characters are inherited. Diminish the food supply and abolish physical training, and the size would sink to the level at which natural selection had left it. Physical training in civilized races being usually more adequate in the case of man than of woman would, perhaps, explain why man has progressed more rapidly in size than woman. It seems impossible, taking variation as a measure of the intensity of selection, to reconcile the relative increases in size of man and woman with any direct effect of natural selection.

8. To sum up, then, the following results seem suggested by these measurements:

(i.) Civilized man has progressed generally on primitive man in size, variation and correlation.

(ii.) This progression can hardly be accounted for by increased selection (because of the increased variation), nor by decreased selection (because it is inconsistent with the relative changes in male and female size). It might possibly be accounted for by decreased selection and improved physical conditions.

(iii.) Woman is more variable than man in civilized races.

(iv.) Woman is more highly correlated than man in civilized races.

(v.) In uncivilized races the sexes are more nearly equal in the matter of size, variation and correlation than in the case of civilized races.

(vi.) It is impossible to say that civilized woman is nearer to the primitive type than civilized man, for while civilized man differs more from the primitive type than civilized woman, so far, probably, as abso-

* Conclusion of a communication made to the Royal Society.—Science.

* This is only generally true, not in every individual case. The French femur is longer than that of the Aino, of neolithic man, and of the ancient inhabitants of the Canary Islands. On the other hand, the French femur appears to be slightly less than the Libyan, although the humerus is somewhat greater. The French women appear in all long bones less than the Libyan woman.

late size is concerned. he has made only about half her progress in variation, and hardly any progress at all in correlation.

(vii.) The causes (e. g., lessening of selection) which lend to increase variation may also increase correlation. In other words, the intensity of the struggle for existence is not necessarily a measure of the intensity of correlation.*

The measurements made by Mr. Warren on the Libyans, the results of which he has kindly favored us with, are, on the whole, fairly in accordance with the above conclusions. He finds for the—

Mean of the sexual ratio of		the means	1·092
"	"	" the variations..	1·028
"	"	" the correlations	1·008

The corresponding quantities for the French are: 1·109, 0·930, 0·956, or, we concluded, that in passing from uncivilized to civilized peoples, from Libyan to French, the men gain on the women in size, here very slightly, and the women gain upon the men very markedly in variation and correlation.

These results are merely suggestions, but they may possibly serve to emphasize the importance of a careful measurement of the long bones of, say, 100 members of both sexes for a series of civilized and uncivilized races. In the former case at least there does not appear to be any real difficulty, except the need of co-operation, in obtaining measurements similar to those of M. Rollet, for both English and Germans. The value of such statistics for comparative purposes would be very great.

ALICE LEE,
KARL PEARSON.

* The mathematical theory of selective correlation shows that the close selection of an organ, say the femur, may actually tend to reduce the correlation between two other organs, say the humerus and the radius.

AVALANCHES.

THE causes and effects of avalanches have been known for so long a time that it is unnecessary for us to dwell upon the subject. There are, however, two kinds of avalanches—those that are looked for and those that take place unexpectedly. The former of these are the ones that, as a consequence of the conformation of mountains, have worn away a path that they follow regularly every year and that are called by the name of the place where they fall. Among these, and one of the most important in the region of Davos Platz, is the one that falls at the place called Schwabentobel (Fig. 1) upon the post road running from Davos to Thusis (Grisons). As such avalanches are expected, methods of defense and relief are provided against them, such as the construction of tunnels or parapets upon the mountain side. Fig. 2 shows what a quantity of snow an avalanche carries with it.

An avalanche that belongs to this category is the one represented in Fig. 3, which falls regularly from the Schwarzhorn behind the hospital of the Fluela (passage of the Fluela from Davos into the Engadine).

These avalanches, being foreseen, generally prove harmless, but such is not the case with those that we place in the second category; for instance, take the one that fell on the sixth of February, 1897, at about a hundred yards from the hospital of the Fluela and buried five men and eight horses. Two convoys were crossing over the road when a formidable noise was heard coming from the Weisshorn tirat. Before a single person could stir, men, horses and wagons were swept away like bits of straw by the wind of the avalanche, and the men and horses probably asphyxiated before being thrown against the opposite wall (Schwarzhorn) and covered by the avalanche.

The snow that fell for four hours covered this scene of horror, and at present we would scarcely suspect that there had been an avalanche at the place where the mail passes. And yet the road is a hundred feet above the true one.

The avalanche was 1,300 feet in width and passed over an extent of about half a mile. At a place where two horses and three men were found the avalanche was from 50 to 65 feet in depth. There are two bodies that have not as yet been found, after a search of more than three months. It is supposed that they are at the bottom of the avalanche, and it will be necessary to wait until the snow melts in order to recover them.

Upon these heights (the passage is at an altitude of 7,870 feet) there are no trees or other vegetation to hold avalanches back, and so their effects are always terrible, and there is not a year passes in which a few deaths do not have to be recorded.

The figures that accompany these few lines reproduce photographs that were taken by M. Sigrist Hender at Davos-Platz. They give an idea of what an avalanche of snow is in the mountains of Switzerland.—M. Picard, in La Nature.

FIG. 1.—THE POST ROAD OVER THE SCHWABENTOBEL BEFORE THE AVALANCHE.

FIG. 2.—THE SCHWABENTOBEL AVALANCHE—THE ROAD OBSTRUCTED.

FIG. 3.—PASSAGE OF THE FLUELA—AVALANCHE THAT FELL FROM THE SCHWARZHORN BEHIND THE FLUELA HOSPITAL.

THE PRODUCTION OF PRECIOUS STONES IN 1895.

UNDER this title Kunz* reviews the chief features of the gem industry for the year, giving specially copious details concerning the American production.

A six carat diamond was found at Saukville, Wis., six miles from Milwaukee. In California several diamonds were found, one at Alpine Creek, Tulare County, five near Oroville, Butte County, and about as many more from near the "head of the creek," probably referring to one of the sources of the Feather River. From the association with peridotite, it seems probable that more may be found in this region.

In South Africa the De Beers Company produced diamonds to the value of about $15,000,000 in the year ending July 1, 1895, and the output of the same company for 1896 has been sold for $36,000,000. The total of the dividends paid by the South African diamond companies in the past ten years has been $58,000,000. A 640 carat diamond called the Rietz, found in 1895, is superior in quality to the Excelsior (971 carats) discovered a year or two earlier. The extent of the South African deposits is much greater than hitherto supposed, and many new workings are being opened. Near Winburg, in the Orange Free State, diamond diggings of a prehistoric race were discovered.

Stutzer states that the diamonds of New South Wales occur in a Tertiary (?) deposit, and may have been derived from an intrusive mass of peridotite, now serpentinized. They are said to be of better quality than those from South Africa.

The great advance in the price of carbonado, which has trebled in value, has stimulated the search for substitutes. The only source of carbonado is Bahia, Brazil, where a single lump, weighing 3,073 carats, was found during the year. The practicability of using artificial diamonds seems improbable in the light of Moissan's experiments, who has made several hundred crystals with a total weight of about ½ carat on an outlay of $2,000. This is about 2,000 times the value of natural diamond powder.

Mr. Kunz has named the hydrocarbon to which the phosphorescence of certain diamonds is attributed, Tiffanyite.*

Rubies have been found in place near Franklin, Macon County, N. C., in decomposed gneiss with garnets and chlorite.

Brown and Judd † have recently described the occurrence and methods of obtaining the rubies of the noted Burmese mines, where the paragenesis is much like that of the corundum at Orange County, N. Y., and Sussex County, N. J. In Siam rubies and sapphires have been obtained during the past few years from the Pailin Hills. From Black Creek, New Zealand, rubies are also reported. Sapphires and a few rubies are gotten by sluicing the detritus of a decomposed limestone in Fergus County, Montana. The outlook in this locality is promising. The Montana rubies and sapphires are extremely varied in color.

A number of rich green tourmalines were found in 1895 at Mount Mica, Paris, Me. Five of these were cut into gems of from five to fifty-seven carats in weight. At Haddam Neck, Conn., five hundred dollars' worth of tourmalines of various colors were obtained.

Turquoise is reported from Cripple Creek and from Castle Rock Spring, Col. A mixture of prosopite and quartz closely resembling turquoise was found at Provo, Utah.

Unusually fine opals from near Salmon City, Idaho, as well as other occurrences of opal in Idaho, Washington, Oregon, Arizona, California, Colorado and Georgia are mentioned. Australian opals were sold for more than $100,000 in 1895.

In addition to the above named gems, mention is made at greater or less length of andalusite, cyanite, garnet, quartz, amethyst, chrysoprase, plasma, moss agate, labradorite, lapis lazuli, thalcebrusite, realgar, amber, xenotime and monazite.

The total value of the gem production in the United States for 1895 is placed at $113,621, of which $50,000 is accredited to turquoise.—American Naturalist.

* Seventeenth Annual Report of the U. S. Geol. Survey, 1896, pp 896-926.

* Trans. N. Y. Acad. Sci., May 20, 1895, p. 260.

† Phil. Trans., vol. 187, A, pp. 151-228.

CLOUD AND WAVE STUDIES.

THE old days of blank white skies have practically passed away so far as the walls of our exhibitions are concerned, and even the beginner in photography now desires to obtain clouds either on the same negative as his landscape or on a separate plate. It is not

difficult to obtain clouds at the same time as the landscape, provided a few precautions are taken.

The simplest way to obtain clouds simultaneously with the landscape is to use isochromatic plates with a yellow screen, the sole purpose of the latter being to cut down the strongly actinic blue light from the sky. The particular depth of screen is a matter of judgment, though as a rule the palest that of commercial screen is quite deep enough for all ordinary clouds, and it is only when the light, feathery cirrus—so well known as the mackerel sky—appears that a darker screen need be used.

Even with ordinary plates clouds may be obtained if a foreground shutter be used—and there are one or two cheap double drop or window blind shutters on the market which are very effective. The only thing to be careful about is to note that the aperture of the shutter is sufficiently large not to cut off the illumination of the corners of the plate. With one of these shutters it is possible, by carefully manipulating the strings actuating the sliding pieces, to give at least four or five times more exposure to the foreground than to the sky, and without the slightest sign of a line of demarkation, provided the sliding pieces are kept on the move. If such a shutter be used with an iso plate and yellow screen, far better results can be obtained, and the yellow screen may be entirely done away with.

When it is desired to obtain clouds on a separate plate, care should be taken not to point the camera too high, and to include, as far as possible, a small portion of the landscape as well. The lens need not be stopped down very much—about $f/11$ or $f/16$ will be quite enough—and with a rapid plate and a shutter working about $\frac{1}{25}$ of a second, good clouds can be obtained. If a yellow screen is used the exposure may be increased to $\frac{1}{8}$ second, or even more if a very dark screen be used, but this is unnecessary unless the clouds are really required for meteorological and not pictorial purposes. Too short an exposure makes it difficult to obtain correct rendering of the sky, just as too dark a yellow screen will have the same effect. On the other hand, too long an exposure will cause the cloud forms, particularly if at all delicate, to be entirely lost. Almost as important as the exposure is the development of the cloud negatives—and care should be taken not to push development too far, so as to obtain too great a contrast, and yet, at the same time, negatives which are too thin will not print well. There is one little point in connection with printing in of clouds, particularly on gelatino-chloride paper, and that is to see that the cloud negative is approximately the same color as the landscape, for, if not, the final tone of the sky will be totally different. This is particularly noticeable when a sky is tinted by sunning down with a card, while the landscape may have been printed from a yellow stained negative.

When we desire to obtain clouds and wave studies combined, it will be found that all the directions given above will be satisfactory. One of the greatest mistakes in the taking of wave studies is to drive the shutter too quick. This means that the wave looks frozen, while with a longer exposure there is some fuzziness which gives one a far better idea of moving water. Even for quickly moving water, less than $\frac{1}{50}$ of a second is rarely required.—Photographic News.

INSANE JOURNALISTS.

"In several of the English lunatic asylums," says a writer in a French medical periodical, "the management has had the happy and original idea of introducing journalism among the inmates as a curative measure, and according to the reports furnished annually, the innovation has been attended with the best effects. Some of the physicians even declare that in many instances they have been indebted to the lucubrations of their patients for valuable hints as to the best way of treating them. One demented person, for example, obstinately refused to take any food, and with equally invincible stubbornness declined to furnish any reason for his refusal. There was no difficulty, however, in persuading him to commit his thoughts to paper, for apparently the cacoethes scribendi is quite as powerful among people who have lost their wits as it is among those who have contrived to preserve them, and at once this individual's peculiar delusion was made manifest. This is what the hitherto intractable monomaniac wrote: 'I desire to be buried as quickly as possible. It is a monstrous scandal that I should be compelled to drag about all over this house a dead and putrefying corpse.' As soon as the bent of the patient's weak-mindedness was thus brought to light, he received appropriate treatment, and is said to have eventually recovered." The French commentator selects the New Moon, which he justly regards as very appropriately named, for especial commendation, but he omits to say where this journalistic luminary rises. He quotes from it the following passage, which shows, at all events, that a sense of humor is compatible with lunacy: "Wanted for a throne, which it would be indiscreet to specify at present, an emperor or king who is thoroughly conversant with the business. It is quite useless for the Czar of Russia to reply to this advertisement." We may inform our contemporary that journalism by lunatics for lunatics is by no means a novelty in our establishments for the insane. Writing in 1857, Dr. Andrew Wynter said, with reference to Murray's Royal Asylum at Perth: "Not content with these efforts, they seem to think that they are nothing unless critical, and accordingly they have set up a journal in which they review their own performances. The first number of Excelsior is now before us, in which we find poetry, news, and criticisms on music and contemporary literature; and he who reads with the idea of finding anything odd in this production will most certainly be mistaken, for no one could divine that there was a 'bee in the bonnet' of printer, publisher, and contributor." Any one interested in the history of lunacy and its treatment in modern times will find much curious information in Dr. Andrew Wynter's article. It was published, together with several other papers by the same author, by Mr. Robert Hardwicke, of Piccadilly, in a volume called "Curiosities of Civilization"—having appeared previously in the Quarterly Review, says the Lancet.

It is stated by one of the heads of departments of the London and Northwestern Railway that that company issues yearly fifty tons of railway tickets.

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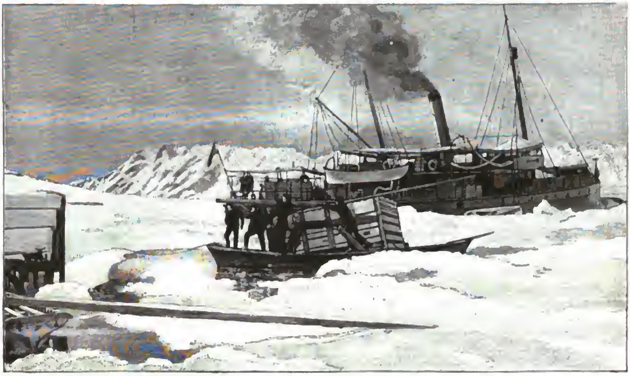

TRANSPORTATION OF THE PACKING CASE CONTAINING THE BALLOON, JUNE 14, 1897.

INSPECTION OF THE BALLOON, JULY 2, 1897.

ANDRÉE'S POLAR EXPEDITION.

ANDRÉE'S POLAR EXPEDITION.

The recent departure of Andrée has once more centered our attention on those northern islands which have so often been the starting place of polar expeditions. Quite fresh in our memories is the sailing of the Fram, and Nansen's home-coming, yet we follow with renewed interest the moves of the daring balloonist, who in his turn defies the prowess which guards the Arctic regions and the pole. It will be remembered that Andrée purposed to enter upon his perilous enterprise last year, but that contrary winds prevented him from carrying out his plan at that time. To avoid the repetition of this turn of events, if possible, and to make sure of his opportunities, Andrée set out for Danes Island fully a month before time. He left Stockholm on the 18th of May and reached Tromsö in a week on board the fine Swedish man-of-war the Svensksund. From Tromsö another nine days or so took him to Danes Island. There he found the balloon house erected the year before still well preserved. Probably a dense snow cover had protected it against the rigor of the Arctic winter. Some alteration had, however, to be made, an addition to the balloon making increased storage room necessary. The diameter of this octagonal building, of which we give an illustration, is 78 feet; the side toward the south, that is, toward the hill, is 65 feet high; the front measures only 57 feet in height. The front was to be torn down as soon as the right wind—the southeasterly wind—set in. The site of this storage house was well chosen. One inducement to its adoption lay in the previous location there of Pike's little wooden hut. Pike, an English sportsman of means, made this place his station, from which he started his hunting expeditions. The house was unoccupied of late, on account of an illness of its owner, and had been placed at Andrée's disposal. We give a cut representing this hut, on the left hand side of which can be seen the gas generating plant. Andrée availed himself of the log house mostly as a store house for his provisions and as a pigeon loft. With regard to the attempts at sending messages with these birds, we fear that they were scarcely promising. The pigeons sent last year did not reach their destination, and probably they were attacked and overpowered by the large Arctic birds on Bears Island, which lies on the way to the continent, and where the winged message bearers rest on the way.

On the 14th of June, the balloon was transported from the Svensksund to its storage house by sledge, as in our illustration. It was filled, and carefully examined for leaks. This is done by applying to the surface of the envelope paper saturated with acetate of lead solution. The sulphureted hydrogen in the gas turns these strips of paper black if it comes in contact with them, and this being a very delicate test, any slight leak is easily detected. The operation involves the scaling of the balloon, and requires considerable agility on the part of the workers. Our illustration will graphically present this fact to our readers.

On the 27th of June, the balloon was announced ready to start. The filling had taken eighty-nine hours, being begun on June 19, and completed on June 22. The provisions, packed in bags, lay ready for shipment, the car was ready, too, and the balloon, with the addition mentioned above, rose to a height of 70 feet. Stretched over it was placed a covering of sail cloth, as a protection against rain or snow, while tight felt strips provided a resistance against the internal pressure.

Of the front of the storehouse two stories were already pulled down. The corner posts could readily be hewn down, so that the balloon could freely emerge to the north. Andrée intended to make his ascent on July 1; however, the wind was predominantly from the north.

The Gunboat Svensksund.

THE BALLOON HOUSE IN VIRGO BAY, DANES ISLAND.

Gas pipe to balloon.

PIKE'S LOG HOUSE ON DANES ISLAND AND GAS WORKS.

On the 11th of the same month, all being ready and the breeze blowing from the south, Andrée, with his companions' assent, gave orders for departure. Before ascending, the head of the expedition sent telegrams to the King of Sweden and to his Swedish fellow citizens, the former to express his gratitude for the support given, the latter to give notice of his starting and to tender his farewell.

Then the ascent began. It took place under altogether favorable circumstances, amid a thunder of cheers and godspeeds. The balloon rose some 650 feet, then sank again to sea level, and finally ascended for good after the aeronaut had thrown some ballast. With a velocity of about 22 miles per hour it was carried north, remaining in sight for one hour.

The 13th of July the Svensksund left Danes Island on its return journey, and during the whole time of crossing faced a southwesterly wind; perhaps in the further north the aeronauts were fortunate enough to find what they hoped for—a more favorable wind.

ANDRÉE'S BALLOON, THE ADLER.

Andrée started with the same absolute confidence in his craft which has so fortunately led Nansen on his expedition; let us hope that, like his sea faring predecessor, Andrée will be safely brought home, and that his return may mark a new period of advance, of additional knowledge gained in a field which for centuries has called the braves of many nations to risk their lives for the sake of science and in search for truth.

Our illustrations are taken partly from L'Illustration and partly from Illustrirte Zeitung.

The stock company for automatic sale in Germany has received permission to place in the post offices of Berlin automatic machines selling post cards and stamps. For their trouble in putting up these automatons the company are permitted to sell by a similar machine on their own account post cards with local views.—Uhland's Wochenschrift.

THE FLORIDA SPONGE INDUSTRY.

By WILLIAM B. BURK, in the American Journal of Pharmacy.

SPONGE is a substance with which almost every one is familiar, as there are but few living in civilized communities who do not find occasion to use it for a great variety of purposes. The article is so very useful that a large number of inconveniences would arise if it could not be obtained. Without it, what would the surgeon, the traveler or the housekeeper do? And yet most of those who use sponges in an infinite variety of ways all their lives never stop to consider how they are formed; that is, whether they are plants or animals, or what their history or habits may have been.

Sponges consist of a framework, or skeleton, coated with gelatinous matter and forming a non-irritable mass, which is connected internally with canals of various sizes. The ova are very numerous, and present in appearance the form of irregular shaped granules derived from the gelatinous matter which grow into ciliated germs, and, falling at maturity into small canals, are then expelled through the orifices. When alive the body is covered by a gelatinous film, which, being provided with cilia, causes a current of water to pass in at the smaller pores and out at the larger apertures, the sponge probably assimilating the nutritive principles contained in the water.

Sponges are found abundantly in tropical waters generally. They gradually decrease in numbers toward the colder latitudes till they become entirely extinct. They vary in shape. Some are shaped like a vase, others are semi cylindrical, others flat like an open fan, and some are round.

The commerce in sponges is of considerable importance. The great difficulty which is experienced in any attempt to distinguish species results from the extreme susceptibility of all keratose sponges to any change in external conditions. They appear to require, for the production of the forms in abundance, tropical or subtropical seas, and attain by far their greatest development in the number of the forms and species in the Gulf of Mexico and West Indian Seas. The typical forms, the commercial sponges, are essentially confined to the waters of the Bahaman Archipelago and the southern and western coasts of Florida in the western hemisphere and to the Mediterranean and Red Seas in the other.

The Florida sponge grounds form three separate and elongated stretches along the southern and western coasts of the State. The first includes nearly all of the Florida reefs, the second extends from Anclote Keys to Cedar Keys, and the third from just north of Cedar Keys to Saint Mark's. The Florida grounds have a linear extent of about 120 miles, beginning at Key Biscayne, in the northeast, and ending in the south at northwest channel, just west of Key West. The northwestern half of the grounds is very narrow, having an average width of only about five miles, and being limited to the outer side of the reef. At about the Matecumbe Reefs the grounds broaden out so as to cover the entire width of the reefs, which are much broader here than at the north. The entire southern half of the grounds has more or less of the same breadth, which is about 13 or 14 miles.

The second sponging ground begins just south of Anclote Keys, with a breadth of 7 or 8 miles, which it maintains from a point opposite Rat Fort to Sea Horse Reef, just south of Cedar Keys. The total length of this sponging ground is about 60 geographical miles. Its distance from the shore varies somewhat. At the south the inner edge approaches within 4 or 5 miles of the mainland, and comes close upon Anclote Keys; but throughout the remainder of its extent it is distant 6 to 8 miles from the shore until it touches the shallow bottom and reefs of Cedar Keys. The depth of water on these grounds, as indicated on the coast survey charts, ranges from 3 to 6 fathoms, but many portions are undoubtedly shallower than this. The northern ground, which maintains a nearly uniform width throughout, is about 70 miles long by about 15 miles broad. It approaches to within about 5 miles of the shore and terminates just off the mouth of Saint Mark's River; the depth of the water is the same as upon the next one to the south, i. e., from 3 to 6 fathoms. The total area of the Florida sponging grounds, which are now being worked, including also those that were formerly fished upon, but have since been more or less abandoned, may be roughly stated at about 3,000 square geographical miles. This probably does not include all of the sponging grounds occurring in Florida waters, for the fact that new areas are being constantly discovered would indicate that there might still be more to find, and it is certain that no strenuous efforts have yet been made to extend the grounds already known, the discovery of new ones having generally been made by accident.

The sponge fishery of the Florida coast differs from that of the Mediterranean in that sponges are not obtained by divers, but by means of a long hook fastened to the end of a long pole and managed from a small boat.

In Florida small vessels of from 5 to 50 tons measurement are employed to visit the grounds, to afford quarters for the men and to bring home the catch. These vessels are generally of light draught and schooner rigged, having proportionately large decks on which to carry boats, working gear and the sponges caught. The holds are of considerable size, for storing the sponges, and the cabins generally small, indicating a sacrifice of comfort to working room. Each vessel carries, according to its size, from five to fifteen men, one as cook and the remainder as fishermen, and also a small yawl boat to every two fishermen, to be used by them in securing the sponges. In addition to the working tools for taking sponges, they are provided with a sufficient quantity of provisions, wood and water for the trip, lasting from four to ten weeks.

The working outfit for a Florida sponging vessel consists of a few small yawl boats, called dingies, and a supply of sponge hooks and sponge glasses. The boats used are always made as light as possible. They are from 15 to 20 feet long and from 4 to 6 feet wide. The idea is to have the boats light enough to enable two men to haul them in and out over the side of the vessel, and yet strong enough to withstand the rough handling which they are sometimes subjected to, and to carry the heavy loads resulting from a day's catch. While catching sponges it is necessary to scull the small yawl boats (dingies) from the stern, and, for convenience in doing so, this form of sculling notch is used. A piece of oak plank about 6 inches wide and 1 foot long is notched at one end to fit the oar and inserted at the other between two guiding strips well fastened to the stern sheet. This sculling notch is placed at one side of the center of the stern sheet and is made to be easily removable in order that it may be taken out of the way when not needed. The sponge hooks are made of iron with three curved prongs, measuring about 5 to 8 inches in width. The entire length of a hook is about 8 inches, the upper end being made into a very strong socket for the insertion of the pole.

The sponge glass is made from an ordinary wooden bucket, the wooden bottom being replaced by one of ordinary window glass securely fastened by cement. In using a sponge glass it is placed upright on the surface of the water, and the handle of the bucket is placed on the back of the neck of the fisherman with his head thrust down in the bucket. In this way the fisherman can distinctly see very small objects in very deep water, and he can easily distinguish good sponges from those of an inferior grade.

When the sponger discovers a suitable sponge through the aid of the sponge glass, he hurriedly grasps his hook, and, plunging it directly upon the sponge, he skillfully pulls it from its habitation and brings it up to the surface and places it in the boat. As soon as the fisherman collects a sufficient quantity, he takes them to the vessel, where they are spread carefully on the deck in their natural upright position, so as to allow the slimy matter, called "gurry" by the sponger, to run off. During the first stages of decomposition they have a very unpleasant odor, something like decayed fishy matter. After the dingies collect sufficient sponges to make a vessel load, they are taken to what are called sponge crawls, which is an inclosure of about 10 to 12 feet, made generally by placing stakes in the beach where the water is from 2 to 3 feet deep.

Sponges, after being kept on the decks of the vessel

from one to two days, will generally be sufficiently cured to be taken to the crawls, where they are kept for a few days and then thoroughly washed and pounded with a flat stick. They are then placed upon strings of about 6 feet in length and taken to the markets, where they are sold at auction. They are generally sold in lots, and then carefully trimmed and packed in bales weighing from 15 to 100 pounds each, according to quality, the cheaper grades being generally packed in the larger bales.

The principal varieties of sponges found in Florida are the following: Sheep wool, yellow and grass. The Florida sheep wool are the best quality, being of very fine texture, soft and very strong and durable. The yellow sponge is of fine quality, but not strong in texture, and not near so soft or durable as the sheep wool sponges. The grass is very much inferior to the others, not being as strong nor so desirable in shape, and being easily torn.

There are no sponges found in the world to equal the Florida sheep wool for softness and strength, and no better bath sponge can be found than a good solid Florida sheep wool, although they are generally sold for washing carriages, etc. In former years Florida sponges were loaded with lime or sand in order to decrease the price, but of late very few loaded sponges have been placed upon the market.

Sponges in great variety are also found in many places in the West India Islands and in Cuba. The Cuban sponges are the next best to the Florida. The principal varieties found in Cuba or the West Indies are sheep wool, reef, yellow and grass, also velvet, which are next best to the sheep wool.

The finer grades of sponges are found principally in the Mediterranean, such as the fine surgeon's, toilet bathing and nursery sponges, and they are very much higher in price than any others.

Florida produces nearly double the amount of sponges that are imported from all other countries, that is, in value, not quantity, and the demand for good Florida sponges is considerably greater than the supply. Consequently, the prices must advance from year to year. The prices have more than doubled within the last twenty years for Florida sponges.

The fine, soft species of sponges, such as surgeon's, toilet, nursery, bath, etc., are found in great variety in the Mediterranean, and are fished principally by divers, sometimes at great depth. After being brought to the land they are buried in the sand and allowed to decompose, after which they are well washed and beaten with a small stick, and then packed in bags and sent direct to London, and again thoroughly cleaned and packed in cases according to size and quality. The large London dealers have almost complete control of the sponges found in the Mediterranean. There are a great many varieties found there, principally the fine surgeon's, toilet, bathing, potter's, fine thin flat (called elephant's ears by the native fishermen), fine cups, Zimocca toilet, Zimocca potter's, etc. Some of the finest cup sponges are sold at as high as $100 per dozen. The Mandruka bath sponges are also very expensive and very rare. Some of the cheaper species are also found in the same waters, but none like those found in Florida or Cuban waters.

ON THE DISTRIBUTION OF THE PELAGIC FORAMINIFERA AT THE SURFACE AND ON THE FLOOR OF THE OCEAN.

THE pelagic Foraminifera play a most important role in the economy of the present ocean, as well as in the geological history of our planet. Living specimens of these pelagic Protozoa are distributed everywhere in the surface waters of the open ocean, about fifteen or twenty species being met with in the surface waters of the tropics, and one or two dwarfed species are captured among the floating icebergs of the Arctic and Antarctic regions. The dead shells of these Foraminifera make up by far the larger part of the carbonate of lime present in the deep sea deposits known as Pteropod and Globigerina oozes, which cover about 50,000,000 square miles of the ocean's bed. In addition, they make up the major part of the carbonate of lime present in the other deep sea deposits, such as diatom ooze, radiolarian ooze, red clay, and the deeper terrigenous deposits which are laid down in close proximity to continents and oceanic islands. Indeed, it may be said that, taken as a whole, nine-tenths of the carbonate of lime in marine deposits from depths greater than one hundred fathoms is derived from the dead shells of the pelagic Foraminifera.

When the Challenger set out on her cruise around the world, all the naturalists of the expedition believed that the habitat of the Globigerinae was on the seabed in deep water. This opinion was held by Wallich,* Carpenter, and Wyville Thomson. Gwyn Jeffreys, however, took another view; he regarded the Globigerinae as surface organisms, and the Globigerina ooze as made up of dead shells which had fallen to the bottom from the surface waters. The fact that McDonald† and Major Owen had captured several species of these Foraminifera in tow nets at the sea surface appears to have been overlooked or forgotten. Huxley discussed this question, and while not coming to any definite conclusion on the subject, he held that the balance of evidence was in favor of those who maintained that the Globigerinae lived on the bottom of the ocean.

During the first few months of the Challenger expedition the attention of the naturalists was almost wholly taken up with the examination of the deep sea organisms obtained in the trawl and dredge, and with the larger animals procured at the surface. When, however, the expedition entered the tropics, I frequently observed Globigerinae, Orbulinae, Pulvinulinae, and Sphaeroidinae at the bottom of the glass globes into which the contents of the surface nets were washed, and the attention of Wyville Thomson and the other naturalists was called to the fact. It was Wyville Thomson's opinion, however, that these shells really came from the deep sea deposits. It was the custom to sift and wash large quantities of the ooze procured in the dredge on the deck of the ship, and it was believed that some of the shells from the deck being washed overboard were subsequently caught by the tow nets dragging astern. But the appearance of the shells taken in the tow nets was so different from that of those procured from the bottom that I could not accept the above explanation. When the weather permitted, the tow nets were dragged, at considerable distances from the ship, from a rowing boat, and Foraminifera were procured in abundance. By using a water glass I was sometimes able to dip up a single specimen in a glass beaker without in any way touching it. When this

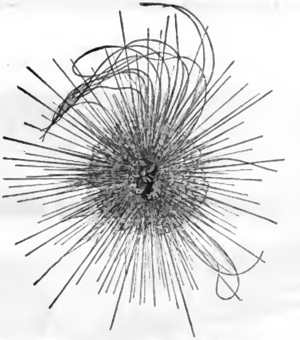

FIG. 1.—Hastigerina pelagica (d'Orbigny) [murrayi, Wyville Thomson] with floating apparatus and pseudopodia extended, as found floating on the surface.

specimen was taken on board the ship, and placed under the microscope, the whole sarcode of the animal was to be seen expanded outside of the shell, as represented in Fig. 1. When our attention was once directed to the subject, the pelagic Foraminifera were observed in almost every haul of the tow net. Many of the Globigerinae, the Orbulinae, and the Hastigerinae are furnished with long spines, and when the animal is expanded the sarcode rests between the spines. In the Pulvinulinae, the Sphaeroidinae, and Pullenine, which

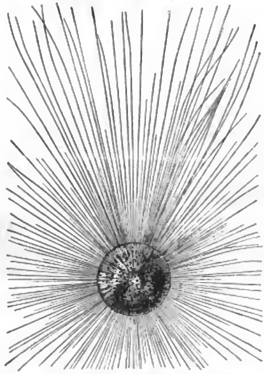

FIG. 2.—Orbulina universa (d'Orbigny), from the surface.

have no spines, the shell is frequently so hidden in the expanded yellow-colored sarcode that it may escape observation.

On the return of the Challenger expedition, the late Mr. H. B. Brady and others pointed out that, if the Globigerinae were pelagic organisms, it was a most extraordinary circumstance that no naturalist had recorded them in any of the numerous tow net gatherings about the British coasts. This, however, quite agreed with the experience of the Challenger naturalists. Whenever the ship entered a bay, an estuary, or indeed any coastal waters, the pelagic Foraminifera became very rare or entirely disappeared from the nets, although they may have been abundant fifty miles from the coast. I have never seen a single specimen in the tow nets around the coasts of Scotland. In the Triton and Knight Errant expeditions pelagic Foraminifera were found in abundance in the Gulf Stream waters which flow up the Faroe Channel, although not a single specimen was observed in the Minch or North Sea waters. The pelagic Foraminifera are truly oceanic creatures, even more so than the pteropoda; they are most abundant in true oceanic currents; where these currents flow directly toward a coast they may be borne close to the shore, but usually they are only to be met with far out at sea.

From an examination of the large number of microscopic preparations and tow net gatherings made during the Challenger expedition, the following species of Foraminifera have been recognized as pelagic:

Globigerina sacculifera, Brady; Globigerina aequilateralis, Brady; Globigina conglobata, Brady; Globigerina dubia, Egger; Globigerina rubra, d'Orbigny; Globigerina bulloides, d'Orbigny; Globigerina inflata, d'Orbigny; Globigerina digitata, Brady; Globigerina cretacea, d'Orbigny; Globigerina dutertrei, Brady; Globigerina pachyderma (Ehrenberg); Globigerina

* The North Atlantic Sea Bed. London, 1862; also Deep Sea Researches on the Biology of Globigerina. London, 1876.

† See Huxley's Appendix to Dayman's Report on Deep Sea Soundings in the North Atlantic made in H.M.S. Cyclops in June and July, 1857. London, published by the Admiralty, 1858.

marginata (Reuss); Globigerina linnaeana (d'Orbigny); Globigerina helicina, d'Orbigny; Orbulina universa, d'Orbigny; Hastigerina pelagica (d'Orbigny); Pullenia obliquiloculata, Parker and Jones; Sphaeroidina dehiscens, Parker and Jones; Candeina nitida, d'Orbigny; Cymbalopora (Tretomphalus) bulloides (d'Orbigny); Pulvinulina menardii (d'Orbigny); Pulvinulina tumida, Brady; Pulvinulina canariensis (d'Orbigny); Pulvinulina micheliniana (d'Orbigny); Pulvinulina crassa (d'Orbigny); Pulvinulina patagonica (d'Orbigny).

Cymbalopora bulloides* (Fig. 3) can hardly be regarded as a true pelagic Foraminifer. It was only captured in the neighborhood of coral reefs, and the curious thing about it is that not a single specimen was taken containing ordinary sarcode, similar to that observed in the other species of pelagic Foraminifera. In all the specimens the shells were filled with immense numbers of minute zoospores; these latter spread over the field of the microscope in a cloudlike swarm when a shell was broken under the cover glass.

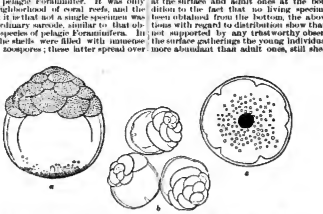

FIG. 3.—Cymbalopora (Tretomphalus) bulloides (d'Orbigny). a, large surface specimen; b, small (young) specimens from the same gathering; c, distal face of the balloon-like chamber, showing the entosolenian orifice, seated in a slight depression. All magnified 60 diam.

The usual color of the sarcode of the pelagic Foraminifera is yellowish brown. In Hastigerina it is bright red, from the presence of red colored oil globules and pigment. This red color enabled me to pick up this species with a beaker on the sea surface more easily than other species. In Globigerina bulloides (hirsuta) and aequilateralis the yellow orange color of the sarcode is due to the presence of numerous oval-shaped xanthidia, or "yellow cells," similar to those found in the Radiolaria. When the sarcode with these "yellow cells" flows out of the foramina, and mounts between the numerous spines outside the shell, the whole presents a very striking object under the microscope; the transparent sarcode can be seen running up and down the long silk-like spines, and the "yellow cells" seated at the base of these spines quite obscure the body of the shell.

The majority of the species in the above list occur within the tropics, and the thick-shelled species occur only in warm water, such as Sphaeroidina dehiscens, Pulvinulina menardii (Fig. 4), Pullenia obliquiloculata, Globigerina conglobata and sacculifera. The number of species becomes less in the temperate regions, Pulvinulina micheliniana and canariensis, Orbulina universa (Fig. 2), Globigerina bulloides and inflata being the prevailing forms. In the Arctic and Antartic regions Globigerina dutertrei and pachyderma, together with very minute specimens of Globigerina bulloides, appear to be the only forms present in the surface waters. The gradual disappearance of the tropical species, and their replacement by other species, as the colder water to the north and south of the equatorial regions is entered, has always appeared to me rather puzzling, especially when it is remembered that these changes take place in a continuous oceanic current, like the Gulf Stream, flowing from the equator toward the poles. It sometimes seemed as if the one form slowly passed into the other with the changed conditions of surface temperature.

The same species inhabit all the great oceans, but in the Indian and Pacific Oceans certain species appear to predominate, for instance, Pullenia obliquiloculata

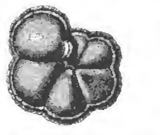

FIG. 4.—Pulvinulina menardii (d'Orbigny), from the tropical deposits.

and Globigerina aequilateralis; on the other hand, Pulvinulina menardii and Globigerina rubra appear to be more abundant in the tropical Atlantic.

The species inhabiting the north and south temperate regions and the species inhabiting the two polar regions appear to be nearly if not quite identical.

The distribution of the dead shells of the pelagic Foraminifera on the floor of the ocean corresponds exactly with the distribution of the living specimens at the surface of the sea. It has sometimes been urged that the dead shells of tropical species might be carried a long way to the north or to the south by oceanic currents, but this does not seem in any way to be the case; the distribution of the dead shells on the bottom does not appear to be much if any wider than that of the living specimens at the surface, and this shows that the dead shells must reach the bottom a very short time after the death of the organisms. The fact that the distribution of these shells at the bottom of the ocean is governed by the surface conditions is of itself almost conclusive proof that they live only at the surface, for otherwise their distribution would be similar to that of bottom living, or benthos, species, which is wholly independent of the temperature conditions prevailing at the surface of the sea. Carpenter and Brady at one time held the view that young individuals lived at the surface and adult ones at the bottom; in addition to the fact that no living specimen has ever been obtained from the bottom, the above considerations with regard to distribution show that this view is not supported by any trustworthy observations. In the surface gatherings the young individuals are much more abundant than adult ones, still shells as heavy as any in the deposits are occasionally taken in the surface nets. The young individuals are likewise more abundant at the surface than in the deposit, when compared with the adult shells present; this is especially the case in deposits from very deep water. This arises, as we shall see, from the more rapid solution of the young shells as they fall through the sea water to the bottom.

When examining a deep sea deposit it is always possible to say, from a study of the pelagic shells of the Foraminifera, whether the sample comes from the tropics, the temperate or the polar regions, but from the examination of these shells alone it would be extremely difficult to say whether the specimen was from the northern or southern hemisphere.

Off the Agulhas Bank at the Cape of Good Hope, off the east coasts of Australia and Japan, and off the east coasts of North and South America, oceanic currents from different sources meet and mix, and there is a wide range of annual temperature at the surface. In these positions large numbers of pelagic Foraminifera (as well as other organisms) appear to be killed by the sudden changes of temperature, and consequently there are indications that the deposits, so far as due to these shells, are accumulating more rapidly in these areas than in other situations. It is a curious fact also that in these regions the deposits of glauconite and phosphatic nodules are more abundant than elsewhere.

In a certain sense the course of a surface oceanic current can be traced on the bottom by means of these dead pelagic shells; for instance, the axis of the Gulf Stream is marked out by deposits of Globigerina ooze from the Strait of Florida to within the Arctic circle. No similar warm current enters the Antarctic region, and consequently no true Globigerina ooze is found to the south of lat. 50° S. When the Challenger took her first deep sea sounding after leaving Heard Island (in lat. 60° S.) there was much speculation as to what the nature of the deposit would be. I ventured to say that it would not be a Globigerina ooze, founding that opinion on the fact that only one or two small Foraminifera had been observed in the tow nets for several days. When a white colored deposit was brought on board from 1,260 fathoms the laugh was rather against "the philosophers," for in external appearance it greatly resembled the calcareous oozes of the Atlantic. On examination, however, it was found to be a Diatom ooze with only relatively few Globigerina shells.

The most striking peculiarity in connection with the distribution of these dead shells on the floor of the ocean is the fact that they are wholly absent from all the greater depths of the ocean, although at the surface their living representatives are as abundant over these deep areas as elsewhere. If we suppose a volcanic cone to rise from the greater depths of the ocean up to within 400 or 300 fathoms of the surface, it will be found that the summit of this cone is covered with a calcareous deposit for the most part made up of the dead shells of pelagic organisms. The deposit may contain 90 per cent. of carbonate of lime, and in it every species of shell met with in the surface waters of the region is represented. As we descend the sides of this cone into deeper water, the thinner and more delicate shells, like Candeina and Hastigerina, disappear first from the deposit (along with the Pteropod shells). In about 2,000 fathoms the deposit consists chiefly of pelagic Foraminifera, and the proportion of young shells is much smaller than in the deposits at lesser depths. With increasing depth the whole of these calcareous shells gradually disappear, till at 4,000 and 5,000 fathoms probably not a vestige of them can be traced, and the deposit all round the cone in 3,000 fathoms becomes a red clay with only traces of carbonate of lime in its composition. Again, if we suppose a basin-like depression on the floor of the ocean, the center of which descends to 4,000 or 5,000 fathoms, while the rim of the basin has only a depth of 1,000 or 2,000 fathoms, then, on the rim, deposits of Pteropod and Globigerina oozes will be found with 70 or 80 per cent. of carbonate of lime, while the center of the basin will be occupied by a red clay with probably not a trace of these carbonate of lime shells. The gradual disappearance of these calcareous shells with increasing depth is evidently due to the solvent action of sea water, and especially of deep sea water. In the lesser depths a very large proportion of these surface shells seem to reach the bottom before they are completely dissolved, and accumulation takes place. With increasing depth the more delicate shells are dissolved before reaching the bottom, and accumulation becomes slower and slower, the last traces of these shells observed in the deposits with increasing depth being broken fragments of large Pulvinulinae and Sphaeroidinae. The greater quantity of lime in solution which Dittmar found in the Challenger samples of deep sea water is apparently a consequence of the solution of the pelagic shells here referred to.

During the early part of the Challenger expedition, Wyville Thomson was much puzzled to account for the origin of the fine red clay which occupies the basin-like depressions of the sea bed far from land, and he suggested that this was an ash† left behind after the solution of the carbonate of lime shells. He was led to this view by observing that when the shells were taken from the purest samples of Globigerina ooze, and, after being carefully washed with pure water, were dissolved with dilute acid, a small clayey residue of a red color remained behind. I was not satisfied with this experiment, for I observed that the color of the residue varied in different samples, and it seemed to me that the fine clayey matter had infiltrated the shells after they had reached the bottom. I accordingly collected, in the course of several months, about 10 grammes of pelagic Foraminifera from the surface of the sea. When these shells were dissolved in dilute acid not a vestige of residue was observed. It was subsequently shown that the red clay came from a variety of sources, and that in the deep sea far from continents it was chiefly derived from the trituration and decomposition of floating pumice.‡

During the past year or two I have carefully collected all the available temperatures of the surface waters of the ocean, and from these have constructed a map showing the annual range of temperature in different regions of the ocean. This map shows that the surface of the sea may be grouped into five great zones, viz.: (1) A nearly continuous equatorial zone, where the temperature is high and the range throughout the year does not exceed 10° F. This zone includes all the principal coral reef regions. (2 and 3) Two polar zones, where the temperature is low and the annual range likewise does not exceed 10° F. In these zones there are relatively few lime secreting organisms. (4 and 5) Two regions lying between the equatorial zone and the two polar zones, where a wide range of temperature occurs between the different seasons (the annual range amounting to as much as 50° F. in some places). In these temperate regions the secretion of carbonate of lime appears to be much more active in the warmer than in the colder months. It thus appears that the most favorable conditions for lime secreting organisms are met with in the warm, equable tropical waters of the ocean, and here as a matter of fact we find the greatest development of corals, and the largest number of lime secreting pelagic organisms. In the polar areas and in the cold water of the deep sea there is, as is well known, a feeble development of all carbonate of lime structures in marine organisms.

From experiments which have been carried out by Mr. Irvine and myself at the Granton Marine Station, we have reason to believe that this distribution is dependent primarily on the physical or temperature conditions of the oceanic waters. When carbonate of lime is precipitated by alkaline solutions, such as carbonate of soda, carbonate of ammonia, or carbonate of methylamine, the effect of temperature is very marked, and it appears to be the case that the secretion of carbonate of lime by organisms is of the nature of a fine precipitation in the interior of the soft structures.‡ If we add sufficient carbonate of ammonia to sea water at different temperatures to convert all the lime salts present into carbonate, we obtain a precipitate which varies both in its crystalline form, in amount, and in time of formation. At 32° F. the precipitate begins to form in about six hours as small but distinct crystals

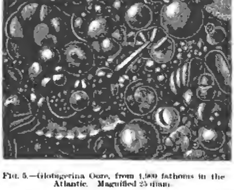

FIG. 5.—Globigerina Ooze, from 1,000 fathoms in the Atlantic. Magnified 25 diam.

of calcite, the quantity in twenty hours amounting only to 0·2 gramme from a liter of water. At a temperature of about 47° F. a mixture of calcite and aragonite is precipitated; at 80° to 90° F. the quantity precipitated is about 0·6 gramme, the precipitate begins to form in from a half to one hour, and it appears to consist of minute crystals of aragonite. It thus seems evident that carbonate of lime would be more easily and more rapidly secreted in the high temperatures of the tropics by means of the effete products of the organism.

As is well known, carbonate of lime in any form is easily soluble in water containing carbonic acid, and the aragonite form is more quickly soluble than the

* See Narr. Chall. Exp., vol. i, pp. 908-9, 1885.

* Proc. Roy. Soc., vol. xxiii, p. 45, 1874.

† See Murray, Proc. Roy. Soc. Edin., vol. ix, p. 247, 1876; also Murray and Renard, Deep Sea Deposits Chall. Exp., p. 194, 1891.

‡ Murray and Irvine, Proc. Roy. Soc. Edin., vol. xvii, pp. 79-109, 1890.

calcite form in the proportion of about three to two. Both aragonite and calcite are apparently very partially soluble in sea water which does not contain free or loosely combined carbonic acid, but when these dead shells are in contact with decaying organic matter, giving off carbonic acid, they are rapidly dissolved. An experiment with Globigerina ooze in a sea water containing additional carbonic acid showed that the thin walls of the chambers of the shells were first dissolved, leaving rings of the thicker portions of the Pulvinulina shells, for example. Decaying organic matter has a powerful solvent action on carbonate of lime, due to two causes: (1) By the carbonic acid formed as one of the products of this decay, and (2) on account of the formation of sulphides and sulphureted hydrogen, due to the reduction of the sulphides present in sea water.—John Murray, in Natural Science.

EDWARD DRINKER COPE, NATURALIST.*

I.

Bitter constraint, and sad occasion dear
Compels me to disturb your season due;
For Lycidas is dead, dead ere his time
Our Lycidas, and hath not left his peer.†

On the morning of April 13, in a car on my way from a funeral in New York to Washington, a newspaper notice of the death the day before of my old friend E. D. Cope caught my eye. Shocked by the intelligence, I dropped the paper, and memory recalled various incidents of our long acquaintance.

The threnody of Milton‡ in commemoration of his friend Edward King also rose to recollection, and the lines just quoted seemed to me to be peculiarly fitted for the great man just dead. He was, indeed, no longer young and had attained his prime, but he had planned work for many years to come and had well advanced in the execution of some of it. He had truly died before his time and had left no peer; the greatest of the long line of American naturalists was prematurely snatched from science and from friends.

My acquaintance with Cope began in 1859. While looking through the part of the Proceedings of the Academy of Natural Sciences, of Philadelphia, for the month of April, in which my first paper published by the Academy had appeared, I found one by E. D. Cope "On the Primary Divisions of the Salamandridæ." It seems that the papers by Cope and myself had been passed on by the Committee on Publications on the very same day (April 26) and appeared in print in juxtaposition. I had not previously heard of the new devotee of science and read his article with as much interest as my own. A well equipped man had evidently come upon the field, and this was the first of the numerous articles that were destined to appear in an uninterrupted flow for nearly four decades. A few months afterward I met the author in Philadelphia at the Academy. A young man, nineteen years old, about five feet nine or ten inches high, with head carried somewhat backward, and of rather robust frame, stood before me. He had an alert, energetic manner, a pronounced, positive voice and appeared to be well able to take his part in any trouble. His knowledge was by no means confined to herpetology, but covered a wide range of science, and his preliminary education had been good. We afterward met from time to time in Philadelphia and Washington, and found we had many sympathies in common and some differences.

In one of our first interviews we had quite an argument on the nature of the family group in zoology, resulting from criticisms I made on the extended scope he had given to that category in the classification of the salamanders. Another controversy, I remember, had reference to the vertebral theory of the skull. In an article on the venomous serpents, published in the Proceedings of the Academy for 1859, he had defined the group in terms involving the adoption of that theory, and I ventured to dissent from its reality. I had myself been much impressed with it in former days, and when sixteen years old had copied in colors an illustration of Owen's so-called archetype reproduced in Carpenter's Physiology. Subsequently, however, the fact that there was only an approximation to the realization of it in the most specialized of fishes and not at all among the lower or higher vertebrates, with other considerations, turned me from it, and I gave my reasons for dissent to Cope. Ultimately he admitted the force of the argument and also abandoned the theory at one time so popular in England and America.

Our acquaintance thus begun in 1859 continued uninterruptedly till death divided us. We rarely met, indeed, that we did not express difference of opinion respecting some subject, but the difference was never of a serious nature and generally little more than sufficient to enliven intercourse.

The future naturalist was born in Philadelphia on July 28, 1840, and the name Edward Drinker was given to him. He was the descendant of a prosperous line long established in Pennsylvania. His father, Alfred, was a man of cultivated literary taste and did much to train his son's mind in early youth. He had retired from active business and lived in luxurious ease in Germantown, a suburb of Philadelphia. There he had formed an arboretum containing most of the American trees which would thrive in the climate of that region. Amid such surroundings the youthful Cope grew up.

An active and intelligent interest in nature became manifest at a very early age. When only about seven years old, during a sea voyage to Boston with his father, the boy is said to have kept a journal which he filled with drawings of "jelly fish, grampuses and other natural objects seen by the way." When eight and a half years old he made his first visit to the museum of the Academy of Natural Sciences of his native city; this visit was on the "21st day of the 10th month, 1848," as entered in his journal. He brought away careful drawings, measurements and descriptions of several larger birds, as well as of the skeleton of an ichthyosaurus. His drawing of the fossil reptile bears the explanatory legend in Quaker style: "two of the sclerotic plates look at the eye—thee will see these in it."

At the age of ten he was taken upon a voyage to the West Indies.* What were the impressions he derived from that voyage we have not been told. But what has been communicated amply justified Professor Osborn in his declaration that "the principal impression he gave in boyhood was of incessant activity in mind and body, reaching in every direction for knowledge, and of great independence in character and action." His school education was mostly carried on in the Westtown Academy, a Quaker institution about twenty-three miles west of Philadelphia. One of his instructors was Dr. Joseph Thomas, a well known literary worker of Philadelphia and future author of a "Universal Pronouncing Dictionary of Biography and Mythology" (1870), and said to be an "excellent linguist." Under his guidance Cope obtained a passing knowledge of Latin and Greek. He appeared to have had no instruction in any biological science and had no regular collegiate training. He did, however, enjoy the advantage of "a year's study (1858–59) of anatomy and clinical instruction at the University of Pennsylvania," in which the illustrious Leidy was professor of anatomy. But, in the words of his literary executor (Professor W. H. Osborn), "it is evident that he owed far more to paternal guidance in the direct study of nature and to his own impulses as a young investigator than to the five or six years of formal education which he received at school. He was especially fond of map drawing and of geographical studies."†

While a school boy he relieved his studies of the classics and the regular course in which boys of his age were drilled by excursions into the fields and woods. Reptile life especially interested him, and he sought salamanders, snakes and tortoises under rocks, stones, fallen trees and layers of leaves, as well as in the ponds and streams of his vicinage. The trophies of his excursions were identified from descriptions in the works in which they were treated, as well as by comparison with identified specimens in the museum of the Academy. He early and almost without guidance learned to use the library and collection of the Academy, although he did not become a member until he came of age in 1861.

Cope's first contribution to the Proceedings of the Academy appeared in the part covering April and was "On the Primary Divisions of the Salamandridæ, with Descriptions of the New Species."‡ In this maiden paper he instituted important modifications of the systems previously adopted in the United States. He soon afterward catalogued the serpents preserved in the museum of the Academy of Natural Sciences and likewise improved upon the systems previously in vogue. He continued with various papers, describing new species and giving synopses or brief monographs of sundry genera of lizards and anurous amphibians.

For five years his publication was confined almost exclusively to the reptiles and amphibians. (The continuity was only interrupted once, in 1862, when he described a new shrew caught by himself in New Hampshire.) Not until 1864 did he begin to extend his field. In that year he described various fishes and a supposed new whale, and gave his first contribution to paleontology in the description of the stegosaurian amphibian called Amphibamus grandiceps. But although his attention had become thus divided, he never lost his interest in herpetology and continued to the end of his life to devote much attention to that department. His studies extended to every branch of the subject, covering not only specific details and general taxonomy, but also the consideration of anatomical details, the modifications of different organs, geographical distribution, chronological sequence, genetic relations and physiological consequences. So numerous were his memoirs, so entirely did he cover the field of herpetology, and so marked an impression did he make on the science, that he was well entitled to apply to himself the boast of the Virgilian hero, "Pars magna fui."

In his earliest essays he manifested the independence and critical spirit which were so characteristic of him later. One knowing all the circumstances of the case may be amused in coming across a passage expressed in the tones of a veteran published by him when twenty years old: "In proposing the name Zaocys . . . we are giving expression to an opinion long held by us as to the unnatural association of species in the so-called genus Coryphodon. . . . In it we find cylindrical terrestrial species united with compressed subarboricole species, upon a peculiarity whose value as an index of nature appears to us entirely imaginary. The very nature of the coryphodontian type of dentition, as distinguished from the isodontian and syncranterian, would lead us to infer its inconstancy;" and so on.§ Bold as was the criticism of such herpetologists as Duméril, Bibron and Günther, it was justified by the facts, and the young author's conclusions have received the indorsement of the best succeeding herpetologists, including even the latest author criticised.

In 1863 he paid a visit to Europe, partly for the benefit of his health, which had suffered from overwork, and partly for the purpose of seeing the great museums of England, France, Holland, Austria and Prussia. Notwithstanding his ailments, he made good use of his time abroad and systematically examined the collections of reptiles in the chief centers of science. He did not even restrict his studies to herpetology, but extended them to various other subjects.

On his return from Europe, in 1864, he was appointed professor of natural science in Haverford College, an institution chiefly supported by Quakers, but retained the position only three years. During this time, in 1865, he married Miss Annie, daughter of Mr. Andrew Pim, of Chester County, Pa.

In and after 1864, too, he enlarged the range of his studies and publications, and also extended them to ichthyology, mammalogy and paleontology. He had always been interested in the philosophical aspects of science and early adopted the conception of descent with modifications to account for the variations of animals and the differentiation into species and higher groups, and in 1869 began to give expression to his peculiar views.

On the death of his father he became heir to a considerable fortune. Part of this was invested in mines, which for a short time gave promise of good returns, but, it is said, the majority of the stock was held by others, and owing to the incapacity of superintendents and the operations of the controlling stockholders he lost his interests. While in the enjoyment of his fortune he spent large amounts in collections and personally conducted or sent out expeditions to various places. One of the most important was sent to South America. He filled a large house from cellar to topmost story with his collections and resided in an adjoining one.

In 1871 he conducted an expedition to Kansas and especially investigated the Cretaceous beds of that State and collected their fossils. In 1872 and 1873 he became connected with the United States Geological Survey, and for the fossils visited Wyoming in the former year and Colorado in the latter. In 1874 he joined the survey under the command of Lieutenant Wheeler, of the engineers, and explored New Mexico.

The collections made during these expeditions were large, and the unwearied industry and energy, as well as cares, of Cope were rewarded with many well preserved fossils. These were described in many communications to the Academy of Natural Sciences and the American Philosophical Society, and later in large volumes published by the general government as reports of the respective surveys with which he was connected.

The various investigations thus opened were continued through the succeeding years. His collections continued to grow in spite of reduced means. He refused even to sell portions for which he was offered liberal sums and, at the cost of personal discomfort, held on to them and made his home, for much of the time, in the midst of them, having sold his residential house but kept his museum.

In 1878, he purchased the rights of the proprietors of the American Naturalist and removed it to Philadelphia. Professor Packard, one of the original proprietors, co-operated with him in the editing of it for some years and he was also assisted by various eminent specialists.

In this journal numerous articles of all kinds, including reviews and editorial comments, were published by him. His last words appeared in numbers issued after his death, the leading article in the number for June having been written shortly before his death. It treats of the remarkable mammals of South America known as Toxodontia.

(To be continued.)

* Presidential address by Prof. Theodore Gill before the annual meeting of the American Association for the Advancement of Science, August 2, 1897.

† In the extract from Milton's poem time has been substituted for prime and our for young.

‡ Milton, poems xvii.

* Osborn in Science, N. S., v, 706.

† Osborn.

‡ Proc. Acad. Nat. Sci. Phila., 1859, pp. 122-128.

§ Proc. Acad. Nat. Sci. Phila., 1860, p. 563.

THE COMMON ACCIDENTS OF SUMMER TOURISTS.

By JAMES E. PILCHER, M.D., Captain in the Medical Department of the United States Army.

FOREIGN BODIES.

In camping parties particularly, insects are liable to find their way into the auditory meatus and produce great annoyance and sometimes no little pain. It will do no harm to hold a bright light to the ear in the hope that the intruder may be attracted to emerge, but it is better that every person should know how readily foreign bodies can be floated out of the ear by injections of warm water.

The eye is even more subject to travel accidents of this kind than the ear, and unless the body be embedded in the cornea or conjunctiva, which is comparatively unusual, no emergency is more readily relieved. There is no reason why the laity should not understand the simple maneuver of exposing the lining of the lower lid by looking up, while gentle pressure is made just below the eyelid. The drawing of the upper lid down over the lower is equally easy and often effective in removing the foreign body. In case of failure, the removal may be attained by drawing across the eye, under the upper lid, a little corner of a very soft linen handkerchief moistened with the patient's saliva. Sufferers from this accident should be informed that a slight conjunctival abrasion, produced by a foreign body which has been removed, will continue the sensation of the presence of the body even after it has disappeared.

CUTANEOUS ACCIDENTS.

The burns of the stage of rubefaction and sometimes of slight vesication, produced by the exposure to the rays of the sun of persons unaccustomed to outdoor life, are common to summer tourists. The recognition of the fact that this accident is a genuine burn renders its treatment readily understood. The numerous cold creams and other unguents sold in the apothecary shops serve well enough, but nothing can be better for general use in these cases than the carbolated petrolatum everywhere available.

The same may be said of the lichen tropicus or "prickly heat," to which delicate skins are subject in hot weather. The intense itching of this trifling but exceedingly annoying affection is also usually readily brought within the limits of endurance by carbolated applications. The little jar of carbolated petrolatum is a most advantageous constituent of every tourist's summer outfit.

The more severe inflammation produced by contact with the various species of rhus, the "poison ivy," the "poison oak" and the "poison sumac," is often temporarily treated with advantage in the same manner. These injuries, however, pre-eminently come under the category of matters in which the "ounce of prevention" is particularly applicable, and it is well for persons going into the country for an outing to be able to distinguish them from the harmless growths which they resemble.

The beautiful woodbine or Virginia creeper is distinguished from the venomous "poison vine" by the fact that the leaf of the harmless growth consists of five leaflets given off from a common stem, while that of the toxiferous plant has but three leaflets upon the main stem. The "poison oak," or Rhus toxicodendron, may be detected by the same conformation of leaf. The "poison sumac" or Rhus venenata, which produces a cuticular inflammation similar to those already mentioned, may be distinguished from the ordinary harmless sumac by the fact that, instead of bearing close bunches of red berries at the ends of its branches, its fruit consists of slender clusters of small white berries given off from the axils of the leaves.

WOUNDS.

It is difficult to realize that in this day and genera-

tion any person can be so ignorant as to treat slight wounds with anything but cleanliness and gentle pressure. But the cobwebs, tobacco quid and filthy lond heresies all still have enthusiastic partisans, and slight wounds are exceedingly liable to be transformed into poisoned wounds of considerable extent by the employment of such agents. It is well then to impress upon the traveler the fact that in the wounds of no severity simple cleanliness and gentle pressure, maintained by a clean compress held by a clean bandage, comprise all the requisite treatment. It is worth while indeed to go farther and explain that filthy agents should be eschewed in any kind of wound. Why fresh cow dung or dust permeated cobwebs should be considered to possess healing qualities is a question that the wisest cannot answer. But, with the predilection for those dressings which possesses the bucolic mind, it is a most wise precaution to warn contemplating travelers against them and in favor of clean applications, and to explain that anything contaminated with animal secretions is dangerous, from the mucus laden handkerchief to the sweat saturated shirt—clean paper being better than soiled linen, the ink of the printed sheet being rather an advantage than otherwise. The removal of a barbed fishhook by thrusting the point out through the skin, and then, after breaking off the barb, easily withdrawing it, is so simple a procedure that it seems hardly necessary to mention it, but experience has shown how few of the uninitiated bethink themselves of this very natural maneuver. It should also be understood that the temporary treatment for severe wounds, after checking hemorrhage and placing the parts in a comfortable position, is identical with that for slight ones.

BLEEDING.

The most alarming feature of the more severe wounds is the bleeding, which, in case of an injury to an artery, may be dangerous to life. Every person should understand the difference between arterial, venous and capillary bleeding. The bright red hue and spurting flow of the wounded artery should be recognized as an indication of danger promptly to be treated. The fact that pressure between the wound and the heart will control such bleeding should be impressed on every mind. The simple construction of a tourniquet from a large handkerchief, a bit of a garment, a suspender, or any simple article which can be bound firmly about a limb, and the method of tightening the bandage thus created by thrusting under it a rod of any kind and twisting it until the pressure exerted checks the bleeding, should be a part of the elementary knowledge of every one. To this should be added the fact that firm pressure directly upon the wound, in other than arterial bleeding, is the proper method of restraining the hemorrhage. The laity should be cautioned, however, to immediately apply pressure with the hands directly upon the wound, even in case of an arterial injury, until the extemporized tourniquet can be put in place. Death has been known to occur from an arterial wound while the amateur surgeon was so much interested in manufacturing his tourniquet that he neglected to control the bleeding in the meantime.

FRACTURES.

Some points with regard to fractures may be of the greatest value to the summer tourist—the main point being aptly expressed in the Latin motto, noli me tangere. Fractures and dislocations are so frequently aggravated by meddlesome handling that the dictum to do nothing more than place the injured part in the most comfortable position possible for the patient and retain it there, should be most emphatically impressed upon the lay mind. Extemporized methods of immobilizing the parts in the easiest position should be generally understood, including the utilization of canes, umbrellas, sticks and the like as temporary splints to prevent the accentuation of the pain and the aggravation of the injury by motion at the point of fracture.

SPRAINS

are sometimes fully as painful and disabling as fractures, and, like fractures, they should not be made the object of unnecessary meddling. No injury is more frequent with the summer tourist than the sprain, particularly of the ankle. The mode of vacation life, with its admixture of athletic sports and unaccustomed exercise, particularly predisposes to this accident. The laity should learn to avoid arnica, turpentine, and other abominations in favor of immediate immersion in hot water for a considerable period, followed by elevation of the extremity and gentle retention of the parts by a bandage, the material for which may well consist of elastic flannel.

HEAT STROKE

or heat prostration is one of the more frequent results of exposure to unexpected exercise in summer traveling. It is well for tourists to understand the danger of prolonged exposure to the sun in very hot weather. The use of alcoholic stimulants or the drinking of water in excess should be avoided before going out, and the advantages of applications of cold water to the head in these cases should be well understood.

DROWNING.

As the water enters largely into the plans of summer excursionists, the list of summer casualties naturally presents a large number of cases of drowning. While the great majority of these cases are beyond recovery before the body is taken from the water, there are still many in which artificial respiration, persistently and effectively applied, may restore the pulmonary and cardiac action. The Sylvester method is the most popular, consisting—the patient lying upon his back—of alternate contraction and expansion of the chest, by alternately pressing the arms upon the chest and raising them strongly over the head, from twelve to fifteen times a minute, all this of course after the water in the air passages has been emptied by gravitation. The best authorities believe that artificial respiration is often too soon discontinued, and advise that it be persisted in for from thirty minutes to an hour. It should be remembered that the body, until the lungs become filled with water, is buoyant and will float, not high up, but still with its upper surface above the water; and the addition of the merest trifle of assistance, such as is afforded by a small board, not to speak of an oar or larger floating body, will enable the head to be kept well out of the waves. If, then, one can have self-possession in the very disconcerting moment of submersion, he may be able to keep himself afloat until aid can arrive, or possibly until he can reach the shore unaided.

There are many other points in first aid, easily acquired and readily remembered, the application of which may not only contribute greatly to the comfort and ease of the ill and injured, but will also materially assist the practitioner in his future treatment of the case, should the accident require the ultimate action of a physician; but those here mentioned are perhaps of the greatest importance to the summer tourist. The whole subject is an important one, however, and the question of general instruction in connection with it is coming to be recognized as of steadily increasing consequence, while the number of persons qualified to stand in the breach in emergency is constantly growing, all of which is destined to result in a great saving of suffering in future injuries and a vast diminution in the mortality of future accidents.—Medical Record.

A NEW LAW OF HEREDITY.

THE truth of a law of heredity proposed by Mr. Francis Galton has been verified in particular instances, in a memoir* read by him before the Royal Society on June 3.

He first put forward the law, with hesitation, in his book "Natural Inheritance" (Macmillan & Company, 1889), page 134, because it was founded at that time almost wholly upon a priori grounds. Now, being found to hold good in a large group of cases, there is strong reason for its acceptance, as applicable generally to all qualities in all the higher (bisexual) animals. When it is applied to individual cases, minor corrections should, of course, be made in respect to sexual limitations, prepotencies of particular ancestors, and the like.

The law shows the proportion of the heritage that is contributed on the average by each parent, grandparent, great grandparent, and so on. There must be an average contribution, drawn from each ancestral place independently of all the rest, because cases are familiar to observers in which a peculiarity found in some single ancestor has appeared in one or more of the offspring; the present law expresses its amount.

The general considerations upon which the law was originally founded are four in number, but not equally cogent; there is only one solution that satisfies them all. (1) The consequence of limitation in space on particulate germinal matter, which necessitates the loss of one-half of the total germinal material contributed by the two parents. This is confirmed by the commonly (though not universally) accepted fact of observation in the life history of the germ. (2) The remark already made, that any ancestor however remote may contribute his peculiarity independently of the rest. (3) The contribution of the two parents to the child, being analogous to that of the 4 grandparents to the 2 parents, of the 8 great-grandparents to the 4 grandparents, and so on, make it probable that the latent links of the chain of ancestral contributions form a geometric series of terms, diminishing as we proceed from the ancestor downward. (4) The sum of the contributed heritages must be equal to 1.

These four conditions are satisfied by the series $\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} +$ etc. In other words, by the supposition that the two parents contribute between them $\frac{1}{2}$ of the total heritage of the child; the four grandparents, $\frac{1}{4}$; the eight great-grandparents, $\frac{1}{8}$, etc. Or again, that a single parent contributes $\frac{1}{4}$; a single grandparent, $\frac{1}{16}$; and a single ancestor in the nth generation $1/2^{2n}$. A noteworthy consequence of this is that all the 16 great-great-grandparents taken together are no more efficient than a single grandparent, and only one-quarter as efficient as a single parent.

This supposition does not run counter to the commonly accepted view that the true line of descent stretches from germ to germ, and not (except in, perhaps, a small degree) from person to person; the person must on the average be a fair average representative of the germ; consequently statistical averages which are true of the one would be true of the other also.

The verification of the above theory is the object of Mr. Galton's memoir. Appropriate materials for the purpose were at last found in the registered colors of the pedigree stock of Basset hounds. This stock was started some twenty years ago by Sir Everett Millais, who purchased on the Continent 93 selected hounds for the purpose, and has subsequently interbred their most valuable descendants. A Basset Club has long been established, which publishes an occasional stud book (the latest was in 1896) containing the registered name, parentage, date of birth, and breeder of each hound. The colors are not printed in it, but they are always entered on the form sent by the breeders to the club, and Sir E. Millais kindly had them copied for his use. Now there are two, and only two, recognized varieties of these colors: the one technically known as lemon and white (the word "lemon" standing for any shade between yellow and reddish-brown), and the other known as tricolor, from its containing black as well. So there are only two alternative conditions to be considered: "with black" and "without black;" or "tricolor" and "non-tricolor"—say for brevity, T. or N. It is asserted that intermediate and doubtful cases between T. and N. hardly exist.

The result is a collection (1) of 817 hounds of registered colors, T. or N., descended from parents whose colors are also known. (2) Of these, in 567 cases, the colors of all four grandparents are known; again (3) of these, in 188 cases, the colors of all eight great-grandparents are known. These three sets form the material that is tabulated and discussed, and supplies the requisite means for comparing calculated results with observed ones.

There are numerous points dealt with in the memoir, and explained away, of which there is not space to speak of here; one only need be mentioned, namely the question whether either the sire or the dam is so prepotent in transmitting color as to make it necessary to treat the sexes apart. It proves that the dam is prepotent over the sire in this respect, but only in the proportion of 6 to 5; also that the neglect of sex made no sensible difference in a test case. Consequently all ancestral places in the same generation are treated as of equal average efficiency. In short, if n be the order of any given generation (counting n = 1 for parents, = 2 for grandparents, etc.), there are 2^n ancestral places in the nth order, and these contribute between them $1/2^n$ of the total heritage; consequently each ancestral place contributes $1/2^{2n}$ of it. It the same hound fills more than one ancestral place, he has to be rated separately for each of them.

The contributions from the unknown ancestry are reckoned as follows: It was found that 79 per cent. of the parents of T. hounds are T. also, and that 56 per cent. of the parents of N. hounds are T.: consequently the unknown grandparents, great-grandparents, etc., of the T. hounds would have probably $(0{\cdot}79)^2$, $(0{\cdot}79)^3$, etc., of T., and those of the N. hounds would have $(0{\cdot}56)^2$, $(0{\cdot}56)^3$, etc., of T. A simple calculation shows that the sum of the T. contributions to the offspring of the unknown ancestry of each T. grandparent would be 0·0408, and that of each N. grandparent would be 0·0243; these values are used in discussing the set (2). In set (3) the great-grandparents are known, ignorance beginning above that stage; in this case, the pre-ancestral contribution of T. through each T. great-grandparent is found to be 0·0102, and that through each N. great-grandparent is 0·0061. There is no need here to allude to minor corrections, noticed in the memoir, whose effect is too small to be worth regarding.

It thus becomes a very simple matter to determine the contribution from each several known ancestor as well as that from the unknown ancestry of each of them, and, by adding these together, to obtain a coefficient appropriate to any given group of similar cases, such as, when multiplied into the total number of offspring, shall give the "calculated" number that are T.

The test of the truth of the theory lies in the accordance between these calculated numbers and the observed number.

Owing to the large proportion of T. hounds and to selective breeding in favor of T., the different possible matings are by no means equally common, those in which the known ancestry are all (or nearly all) N. being non-existent. The results for such as occurred are summarized below (excluding seven cases, falling into three groups, that lay outside the limits of the table for set 3). The coefficients are added to show the degree of variety in the test conditions. Fuller information is to be found in the tables published in the memoir, out of which these figures are extracted:

CALCULATED AND OBSERVED VALUES COMPARED.

Set 2

Coefficient	·95	·83	·76	·68	·66	·58	·51	·41	·36	·18	—	Total
T. calculated	106	99	21	8	24	92	32	3	5	1	—	391
T. observed	106	100	24	8	20	79	36	4	7	1	—	387

Set 3.

Coefficient	·96	·94	·92	·90	·87	·85	·83	·81	·81	·79	·78	
T. calculated	2	24	13	14	16	18	13	5	8	3	0	(continued)
T. observed	3	25	24	15	17	19	14	6	8	2	3	

Set 3 (continued).

Coefficient	·75	·69	·67	·63	·64	·62	·60	·58	·56	·54	·52	Total
T. calculated	2	1	1	6	4	17	8	18	8	1	7	180
T. observed	2	4	0	5	1	16	11	8	9	1	7	181

Comparing the totals of each of the two sets, we see that the calculated results are practically identical with the observed ones, 391 with 387; 180 with 181; grand total, 571 with 568. There is therefore no constant error, the errors in individual cases balancing one another. When we examine the several groups, 32 in number, which contribute toward the above totals, a remarkable amount of agreement is shown throughout between calculation and observation, such as would raise the art of breeding to a science of considerable precision. The most notable exception is in the sixth column of set 2, where the numbers are 92 and 79, but, as is shown in the memoir, the observed values run there so irregularly with their neighbors that they cannot be accepted as true representatives. The causes of heterogeneity undoubtedly include the disturbing effects of close interbreeding, because particular hounds of good shape that have also considerable prepotency are largely bred from.

The author mentions that he had made experiments with the coefficients, altering them slightly and recalculating, and that he found in every case a notable diminution in the accordance between calculation and observation; the test that the law has successfully undergone thus appears to be even more severe and searching than might have been anticipated.

It is hardly necessary to insist on the value to breeders of a trustworthy law of heredity. Vast sums are spent annually in rearing pedigree stock of the most varied kinds, such as horses, cattle, sheep, pigs, dogs, and other animals, besides flowers and fruits. Certainly no popular view at all resembles that which is put forward and justified in Mr. Galton's memoir, which is epitomized here so far as space admits.—Nature.

* "The average contribution of each several Ancestor to the total Heritage of the Offspring," by Francis Galton, D.C.L., Sc.D., F.R.S.

CLAY INEBRIATES.

IN some sections of the country a number of people are found who daily use clay as an article of food.

It is used so ravenously and with so much relish, and its effects are so marked, that it can be called a veritable inebriety. The clay eaten is of dirty white color, and has a particular oily appearance and does not crumble, but becomes sticky when moistened. It is held in the mouth until it dissolves, and is swallowed in small quantities. It evidently possesses some nourishment, and the opinion prevails that persons can subsist on it for days without any other food. The

quantity used varies largely from two ounces to several pounds a day.

There is a strange fascination which, like the diseased craving for narcotics, demands so much of this clay every day.

When, by accident or design, the supply is cut off great restlessness, anxiety, and intense depression follow. The effect of clay eating is noted on young persons by blanching the skin, giving it a peculiar pallor, and soon a prematurely old, wrinkled look. The mind seems to be depressed and under a cloud, and all vivacity and emotionalism reduced to a low level.

General muscular indisposition to exertion and indifference as to the consequence of acts and the possibilities of the future are the symptoms in adult clay-eaters. Whisky drinking, tobacco smoking, chewing, dipping, and snuffing are common accompaniments.

All ambition to improve their surroundings and add to the mental pleasures of life is absent, and profound general depression prevails. Superstitious hallucinations and fears of the supernatural, with efforts to interpret every unusual event in nature, and the most primitive struggles to supply the common wants of the body, constitute the whole of life.

Very little sickness follows, and after years of this addiction some acute disease of the stomach or liver is followed by death.

These people occupy some of the mountain counties

POWER ON LAND.

POWER AT SEA.

SCULPTURED FOUNTAINS AT THE HOFBURG, VIENNA.

of the Southern States, and seem satisfied to live in the poorest sections of the country. They are content to live isolated, and by farming, hunting, and fishing make a living.

The craze for the clay used is remarkable for its persistence and tenacity. The supply for daily use is provided with more energy and precision than food.

The skin of clay inebriates soon becomes of a dirty yellow color, and never changes during life. Tobacco using seems to be more closely associated with this addiction than spirit drinking. No change ever takes place except death. They cling to the same ways of life and living, never increasing the amount of clay used to any extent from one generation to the other. Both body and mind slowly retrograde down through degrees of dementia to death.—Quarterly Journal of Inebriety.

THE FOUNTAINS AT THE HOFBURG IN VIENNA.

Two magnificent sculptures were recently unveiled in Vienna (Austria). The façade of the Hofburg there has been restored, and, as of old, forms a semicircle bounded on either side by beautifully crowned wings. At this place the two fountains are raised, bringing out with great force and beauty the originality of the ancient architecture. They bear their white figures on a ground of dark brown marble and represent, respectively "Power at Sea" and "Power on Land."

On the right hand side of the semicircle is the fountain whose figures represent in their powerful allegory "Power on Land." This work of art was designed by Hellmer. The mass of the monument rises artistically in a triangle, at the vertex of which a youth, the type of power, stepping forth from the niche, drives back the powers which threaten from below. One monster, clutching the flowers that adorn the throne, in terror shrinks back, and looks with awe on the conqueror. The second demon falls headlong from the rock, while another makes vain attempts to unbalance the rocks, which, piled up, support the ruler. An eagle with extended wings defends the throne, heedless of the serpent, which is the symbol of treachery, creeping up the rock.

Edmund Hellmer has hitherto shown a liking for the antique, and has dealt largely with wild scenes, as we find them in the beautiful figures and inspired groups of the monument in memory of the rescue of Vienna from the Turks. It would scarcely have been thought that he would render with such clearness the expression of Titanic force. Whoever knows the lightly draped garments on Hellmer's splendid monument, its resplendent armors of the time of the Turks, its heroes of the rescue, scarcely imagines that the hand which carved so bright and lovely a scene could represent crude force in a composition which would fit so aptly with that of Weyr, the artist by whose hand the other fountain was fashioned, and who is accustomed to the treating of such themes. It is clear that he has even surpassed his former productions by this work, and though he is not so full of variety and so picturesque as Weyr, yet he knows how to shape his sculpture uniformly, forcibly, and so as to carry its meaning well. Not quite up to Weyr's level is the statue of the youth.

Though full of the nobility of his character and distinctly great in the expression of his face, the silhouette of this Apollinic figure is not without some faults. Yet it aptly crowns the interesting group which must be reckoned among the most deserving productions of art in our times.

Edmund Hellmer was born at Vienna in 1850, and obtained a government prize as pupil at the academy there. He is now professor at that institution. Nearly all young sculptors of Vienna have passed through his school, or have attended it before going to foreign colleges. Johann Tadrusz, the designer of the "Maria Theresa" monument, and Th. F. Ries, a young Russian sculptress, have lately made their names known in all lands as pupils of Edmund Hellmer.

The other fountain, as we have said, represents "Power at Sea" and is the work of Weyr. A master in decorative plastic art, he has for the first time used his great talent in the service of that artistic effect which must be studied closely, intelligently and into the smallest detail. His productions have so often come to public notice as flowing silhouettes on the gables of buildings that there was naturally some wondering expectation to see how he would fashion these groups, that might as it were be touched, who had hitherto shown such remarkable ability in calculating his playful lines for splendid distance effect. He has solved the problem in a truly wonderful way. The architectural motives, the muscular body of ancient Neptune, who, the trident in his right, looks with amazement on the genius, half man, half fish, falling over the rocks, and the artistically effective Moloch, are grouped in powerful unison beneath the queenly figure which crowns the group. This sculpture, a "Power at Sea," occupies the left niche in the façade. The momentous motion of the combined impressions of this masterpiece, the right side of which, with the fallen demon, is wonderfully conceived, is extremely pleasing to the eye, and gives testimony of virtuose ability in the composer.

The idea of impotent power could not better be depicted than by this work. Technically of great merit are the torso of Neptune and the breast of the crowning figure; a very modern criticism might, however, find fault with the somewhat conventional attitude of arms and legs. In this work Professor Rudolf Weyr has presented his best efforts, and the result is so great that it surpasses the production of most of the Vienna artists.

Weyr was born in 1847, was pupil of the Vienna academy, is known specially for his frieze the "Bacchantes" in the new Burg Theater, the excellent bas reliefs on the "Grillparzer" monument, and for numberless tomb sculptures.

His reputation made him well worthy to add to the plastic decorations of the great Austrian capital.

We are indebted for the views of these fine specimens of the plastic art to the German paper Ueber Land und Meer.

DOES TRACK SWEEPING PAY?

WE venture the opinion that, if more managers would look carefully into the matter of clean tracks versus dirty tracks and the cost of sweeping versus the cost of power, sweepers would be used more liberally than they are now, or at least more track brushes would be used, says the Street Railway Review. Since street railways must be operated in all kinds of streets and since municipal management often decrees that streets must remain dirty for want of street cleaning funds, the only loophole of escape for the manager is to clean his portion of the street himself. The question then arises as to how much sweeping and cleaning is justified by the return therefor in dollars and cents. One concrete example will give some idea of the economy of running a sweeper over tracks once a day, where there is moderately heavy traffic. A double track route 5 miles long, running cars at 5 minutes' headway, at 8 miles per hour for 10 hours of the day, and cars at 10 minutes' headway 10 miles per hour for 8 hours of the day, will require 15 cars during 10 hours and 6 cars for 8 hours of the day. The total mileage during the 5 minutes' headway hours is equal to the 15 cars in service multiplied by 8 miles per hour multiplied by 10 hours, or 1,200 car miles. Adding to this the mileage made by six cars running 10 miles an hour for 8 hours, or 480 car miles, the total daily mileage will be 1,680. Assuming that power costs 1 cent per car mile with a clean track and

the power to run that route costs $16.80 per day, a dirty track may easily make this 20 per cent. more, making the amount to be charged to dirty track $3.26. To run a sweeper once over that route each day would take the time of two men for about one hour, making cost of labor about 40 cents, and allowing 8 cents per mile for power to run the sweeper, we have 30 cents more, or a cost of 70 cents per day to run the sweeper once over that one route to save $3.26. This, of course, does not include sweeper maintenance, but neither does the other calculation include car wheel, track and motor maintenance. The amount saved relative to the cost of sweeping decreases as the traffic gets lighter, but there is a considerable margin of economy in favor of the sweeper, even allowing for a considerable decrease of traffic. Besides this, there are track brushes to fall back on in case it does not pay to run a sweeper, and in many cases sufficient sweeping can be done by a special attachment to one or two cars.

THE BRITISH BATTLESHIP RENOWN.

THE recent naval review at Spithead brought together the most interesting types of war vessels, both British and foreign. The vessel which we illustrate is her Majesty's first-class battleship Renown, 12,350 tons. It was built at Pembroke Dock Yard, from the designs of Sir W. H. White. She is in many respects similar to the Prince George, which we have already described. For our engraving we are indebted to The Engineer and for our description to Brassey's Naval Annual. The Renown was laid down in Pembroke Dock Yard in February, 1893, and was launched in May, 1895. As already stated, she is 12,350 tons displacement, and her estimated speed, with 12,000 horse power, was 18 knots. The machinery of the Renown is by Messrs. Maudsley, Sons & Field. Great interest was attached to the trials of the Renown, as she was expected to prove herself the fastest battleship afloat. This she has succeeded in doing by a very narrow margin over the Victorious, but the latter was tried at considerably less than her load draught. At the trial it was found that for a period of eight hours under natural draught the engines made 97·8 mean revolutions; the mean indicated horse power was 10,708; her speed was 17·9 knots. Under four hours' forced draught the mean number of revolutions was 104·5, the mean indicated horse power was 12,901, the speed was 18·75 knots. On the thirty hours' coal consumption trial the mean draught was 26¾ feet and the mean speed 15·3 knots with 6,189 horse power and 86·9 revolutions. The consumption of coal was 1·88 pounds per I. H. P. per hour. The Renown is protected on the same principle as the Majestic class. The thickness of the barbette armor is 10 inches as compared with 14 inches, and of the side armor 8 inches and 6 inches as compared with 9 inches throughout. The main armament consists of four 10 inch guns as compared with four 12 inch guns. All the 6 inch quick fire guns are mounted in casemates, but only ten are carried instead of twelve. On the gunnery trials the 10 inch barbette guns were fired thirty degrees before or abaft the beam, as the case might be; they were also fired simultaneously directly fore and aft with full charges and at 35 degrees elevation without injuring the ship or the mountings.

The cost of the Renown was about $2,750,000.

HER MAJESTY'S FIRST-CLASS BATTLESHIP RENOWN, 12,350 TONS, CONSTRUCTED AT PEMBROKE DOCK YARD.

The first direct mail connection across the Sahara has lately been completed. It runs from Senegal via Timbuctoo to the north.—Uhland's Wochenschrift.

TOWNS' WATER SUPPLY AND ITS DISTRIBUTION.*

By W. M. WATSON, Toronto.

IT is a crime to supply a town with tainted water or compel those living in villages to depend on wells of doubtful purity, which sometimes run dry when water is most in demand. Abundance of good water in the house convenient for use at will is a sanitary necessity, and it is the duty of the governing body to arrange for and secure a permanent supply at a reasonable expense and charge to the consumer.

When constructing waterworks, care should be taken in arranging and joining the iron street mains and conduits and every other apparatus used for distributing or conveying the water, so that they cannot be injured by frost or dirt or by the pounding of water hammer caused by sudden concussions of confined air. The joints should be well and carefully made, and if lead be used, each joint should be run full and solid at one teeming of the ladle, at least to a depth of two inches. Maiden or new pig lead should always be used for jointing. Each joint should have two circles of hemp rope driven well back and tight for the lead to wedge against. It is the hemp rope that keeps the joint tight; the lead holds it to its place, so it is necessary to have a good quality of rope. Above all else, it is necessary to make proper provision for cleaning out every part of the pipe system and to prevent waste or leakages, which not only wastes money, but damages the roadbeds and the foundations of property adjoining the line of pipes.

Water suitable for domestic use should be transparent, without smell, taste or suspended matters, totally free from any excreta or sewage deposits of any kind. Marsh or nullah water, which is loaded with vegetable débris, must be carefully avoided. Water for industrial purposes should be void of minerals, because they increase the cost of soap and scouring materials when used for cleaning purposes; they scale steam boilers and heating pipes and interfere with the production of colors when dyeing fabrics. The French cloths are always softer to the touch than British, because of the quality of water used in finishing and dyeing, and thousands of pieces of manufactured stuffs are sent over to France from England to be dyed and finished and then returned. Tainted, dirty water, with a mixture of fine sand, would ruin a stuff manufacturer or dyer in a short time. It is advantageous to secure water well aerated, similar to the water at the foot of Niagara Falls or rain water, which, during its fall through the atmosphere, secures (according to analysis made by Dr. E. A. Parks, F.R.S.) a large percentage of oxygen.

D. G. F. Gaskins, C.E., when delivering his presidential address before the British Association of Waterworks Engineers, at Nottingham, last year, stated that to manage a waterworks a knowledge was demanded which could only be obtained by close study, application and practice. This is different teaching to that of a prominent civil engineer, who wrote to me saying that there was no room in Canada for experienced waterworks superintendents, because the colleges were turning out yearly more students than there were such places to fill. If the students fill such positions raw from the colleges without learning the trade and securing working experience, whatever salary or wages they receive, it is little better than robbery of the ratepayers. A valuable engineer never attempts to construct or even manage the construction of systems that have been planned and laid out from his own ideas. He keeps his position and expects the mechanic and manager to faithfully keep theirs.

Mr. Mansergh, in his fifteen thousand dollar report on Toronto waterworks, expressed himself in a way that can only be interpreted to mean that he considered the construction and management of all American waterworks systems of a low standard. He attributed the reason to the fact that the city of Toronto had to pump over one hundred gallons of water for each inhabitant each day, to waste or misuse, adding the important remark, "as in other American cities." The reason why there is a low standard of public works in this country in comparison to the works in the old country is because there is no proper check placed on the local authorities by the government. A single ratepayer, having a substantial grievance and who can prove that the local authorities are wasting public money, or mismanaging the public business, or allowing the public works to be mismanaged, or voting themselves funds, etc., can petition the English local government board, who will send an expert engineer to make a full inquiry, and if abuse of the trust put in the representatives elected by the popular vote be proved, or it is found that any of the officials are not worthy of the confidence placed in them, he will report the same to the government, who will take measures to correct the evil.

I was appointed to investigate a waterworks on which there had been an inquiry of this kind, and I proved that most of the wealthiest manufacturers were daily stealing large amounts of water, and that less than half the amount of water provided by the ratepayers of the town was paid or accounted for. The result of the government interference in this case was a saving to the public taxes of about $30,000 each year afterward.

Mr. Griffith, C.E., states that under proper management the advantages of local authorities owning their own waterworks are as follows:

1. A local authority elected by residents in the districts has a greater personal interest in the matter of supply, and is better qualified to administer the undertaking in their own interest than a private company, whose only object is profits.

2. A local authority need not make any profit out of the supply. They can also borrow capital for construction of the works cheaper than a private firm, and reduce the charges for supply to consumers accordingly.

3. Public sentiment is always in favor of having such a universal necessary of life and health in their own hands.

The chief difficulties against public ownership are:

1. The periodical changes of council and sometimes even the constitution, which often interferes with the continuity of a policy.

2. The liability of the works being handled by men appointed through society, family or political influences, in place of having skilled mechanics and experts.

3. The habit, which is sometimes allowed or blindly ignored, of selling favors and accepting perquisites, which often is the cause of scamp work being done, and of public works costing more than similar works done by private business firms or such well conducted councils as Glasgow.

The revenue from the sale of water in Toronto is stated in the newspapers to be $445,000. Taking the population at the highest stated number, viz., 190,000, it runs about $2.30 per head, an average for each house of five inmates of $11.50. They say we owe on account of the waterworks $3,817,287.32, or an average per head

* Abstract of paper in Canadian Engineer.

of $20.09. Had the Toronto waterworks been constructed and managed by a business firm, with the ability of the T. Eaton Company, for example, it would not have cost half, and the charge to consumers could have been proportionally less.

There cannot be a great difference between the need for water in European and Canadian towns which have similar conditions, only that English towns use a great percentage of their water in supplying cheap public swimming baths of large dimensions. The difference in consumption has no connection with the fact that the heat or cold is more excessive, because the returns given us of the water pumped in Toronto in the months of April and November, when there is no garden or street watering, public water fountains, no frost needing taps to be kept running, nor anything at all different to any British town, gives only a little different figures to those published for any of the other ten months.

Mr. Palmer, C.E., states that the Malvern authorities supply each water consumer with a meter, and the average consumption is 5½ gallons per head per day. I know several small towns that do not use meters which use less than 6 gallons of water for household purposes per head per day. The total quantity of water used for all purposes in the town of Nottingham, with a population of 230,843, last year was stated to be under 21¾ gallons per head per day. In Bradford, a town of 240,000 inhabitants, they used 26 gallons per head through meter for manufacturing purposes and about 27 for all other purposes, including several large swimming baths. Mr. Bateman states that he tested a group of 14 towns in England and found the average consumption for all purposes was 24 gallons, and in a single group of working class houses containing 82 inmates the average consumption per day per head was 7½ gallons. I myself tested a house in Toronto by having a new Siemens water meter fixed on for five years. The house had 11 inmates, 2 baths, 1 basin, w. c., hot water and range boilers, hose pipe, stable and horse. The average amount of water taken each year was under 28,000 gallons, less than 7 gallons per head per day.

The Toronto Star on May 1 stated that only 198,000,000 gallons of water were sold to manufacturers in a year in Toronto, or under 3 gallons per head, leaving about 100 gallons per head per day for sanitary and domestic consumption, or 75 gallons over the consumption of similar British towns. If Toronto were situated in England, there would be a government inquiry into the cause of this waste. Returning again to the mechanical and engineering side of the subject, as I have before stated, the best water for public use is rain water collected from clean land, because it cannot possibly be contaminated by mineral, manurial or sewage deposits. Taking a supply from a river near its source or from an elevated lake is often as good as collecting rain water.

When taken from a river, the mouth of the suction pipe should face the way the water flows, because by so doing the best water will be drawn in, while the floating impurities will pass forward with the current. When from a lake, it should face downward for the same reasons. Taking water from a lower level than the town is built on is often injudicious, because it may be fouled by the sewage from the population living within the watershed, which sometimes contains an area of several thousand square miles, and should the population be small at present and the impurities from the sewage imperceptible, it may soon alter. All large towns should have forethought sufficient to arrange for a good permanent supply while the opportunity serves. To depend on a supply by pumping and long suction conduits is risky and expensive, and it is probably cheaper to carry a supply fifty miles and have a proper gravitation system:

1. Because the source of supply being necessarily at a higher elevation than a pumping source, it is less liable to be contaminated.

2. Though the first cost of works may be more on account of the long length of trunk mains, which might have to be conveyed through tunnels and across ravines on viaducts, yet the annual expenses of pumping, in wages, repairs, renewals, etc., will probably amount to more than would pay the interest on the capital expended on a comprehensive, well engineered scheme. Such a plant would be safe and permanent, besides free from contamination, because by making judicious arrangements to supply the villages located on the route of the pipe by measure, sufficient revenue might be collected to pay the interest on the cost of running the trunk pipe through their section of territory.

When it is necessary to store water in reservoirs so that the supply can be abundant when the rainfall is least, such reservoirs should be carefully covered over and ventilated. In form they should be deep rather than extended, so as to lessen the evaporation, to keep the water cool and at an even temperature so far as possible all the year round, to prevent the water from absorbing the impure gases from the atmosphere and prevent the sun's rays from increasing the microbes and bacteria. When large natural reservoirs are made in the hills, they must necessarily be open, and the face of the water exposed to the sun and air; such water should be passed through a good clean filter immediately before entering the supply pipes. In fact, all water, however collected and stored, should be filtered.

It is a fact that the purer and softer the water is, the easier it is to contaminate. It will attract and absorb minerals and poisonous gases with a wolfish appetite. At Harrogate, in England, there are eleven springs of water, each loaded with different minerals and chemicals, which each stream has taken up on its passage through the earth from the seat of the rainfall to the springs.

Then another example: Six families, living in good, airy, isolated houses, went on their holidays for a few weeks to the seaside. A short time after each family returned home some of its members were taken ill with typhoid fever. Being superintendent of the water supply, it was my duty to investigate so remarkable an occurrence, and I found that the owner had broken the laws of water distribution by allowing his tenants to take the whole of their water supply from a large shallow open cistern, hidden in the false roof, that was open from end to end over all the sleeping rooms of the six houses, and that the loft had no ventilation whatsoever; so that all the poison contained in the atmosphere of the sleeping rooms passed through the porous plastered ceiling, and having no other means of escape was absorbed by the sheet of water in the cistern, and the water became poisoned before being used by the inmates. A French writer has, indeed, proved that the human system can be trained to receive large doses of poison without serious injury. If his theory was incorrect, how could so many people live in a poisoned atmosphere, yet have general good health. The trouble with this group of families was that they had lived at another place for a time and broken the continuity of the doses, and when they returned home and began to take them up again on a healthy, well ordered constitution, the sudden start upset them. The water would be worse than usual on account of a small quantity only having been used during the time of absence. I have related this at length to show the great importance of covering fresh water tanks and reservoirs, and the advisability of erecting them in places sufficiently removed from any chance of contamination.

With the object of removing dirt from the lower points of street water mains, some engineers connect the ends of the pipes together and form a circuit of water down one street and up another. The method does not remove the evil, but distributes over a larger area the dirt or polluted water in the pipes. I believe the circulating policy is adopted in Toronto, for I am sometimes engaged to remove fish and other obstructions from taps and valves. I also notice if a bath full of fresh water stands for a few days, there is a sediment at the bottom. Then water taps and other waterworks appliances only keep in good condition about a quarter as long as at places where the water is free from fine sand and grit. The cost of repairs and renewals on account of fittings being injured by the grit must amount to a large sum throughout the whole city. I once witnessed water flowing from a branch pipe from which a fire hydrant had been removed run black for about fifteen minutes, leaving a large quantity of gritty deposits on the ground, and at another time a six inch water main that had been taken out on account of a defect had about one inch of black and green sludge adhering to the lower side.

The dirt could not lie in that position, nor the water get so far polluted as to run dirt for so long a time, if reasonable provision were made to clean out the pipes and suction conduit, and the conduit were laid in such a mechanical way that the joints could be kept permanently watertight. The proper way, in my opinion, to lay down distribution water mains for a town is to lay the large carrying mains along the roads having the highest elevation, and take out branches commencing with a cut-off valve and air ball, then continue them down along the streets to the lowest points of each street or section of streets, and on the terminating end of each branch pipe affix a full sized sluice valve about ten yards beyond the last service pipe. Round the sluice valve build a well or valve chamber with a gully trap and drain pipe twice as large as the water pipe, and construct the bottom one foot below the valve. Solids and impurities of all kinds contained in water mains that are under pressure are always forced to the lowest points, and can be easily removed by opening the terminating valves about once a month, or oftener, according to the quality of the water, for about one half minute.

Water mains should be as carefully graded as gas or sewer pipes, and have air balls of the self-acting kind fixed at all the highest points, and full sized sluice valves at all the lowest points and dips, so that the whole system may be emptied and cleaned when necessary, and freed from deposits of grit and slime.

It must be remembered that water will run through water without moving the water adhering to the sides of the pipe it is passing through, and if the mains are larger than is needed to pass the supply taken from them, and the water is soft and pure, the motionless water clinging to the sides will set up an action with the metal and become hardened and turn into a brown calcareous matter, and continue to grow and diminish the bore of the pipe until there is just sufficient room to pass the necessary stream, when it will stop and continue in that shape for any length of time. For example, I inspected a fire hydrant intended to protect an isolated hall in a corner of a town, and found that it would not deliver any more water than the common bib water tap on the kitchen sink. On cutting the three inch main to find the cause, I found it calcarized and the bore reduced as above stated, and the whole of that branch line for about one-half mile had to be relaid with new pipes. Had the terminating sluice valve been open full wide once a month, and the dead water clinging to the sides of the pipe let out, along with any calcareous scales that might have started to form, it would never have been necessary to relay, and the hall would not have been in jeopardy for several years.

A 30 inch earthen pipe having cemented joints, that carried water from one storage reservoir to another on the moor land, got its bore diminished by fine rootlets passing through the cracks in the cement joints, growing inside and choking the interior. The calcareous matter growing on the inside of water mains can be removed by a machine called a ferret, which is so constructed that the pressure of water turned on behind it will force it through a moderate length of water pipe, and during its passage it will scrape the inside clean. When this method is used, clean out doors must be provided at short intervals.

Neither large nor small water filters are of any use except proper provision is made for cleaning them easily, because, no matter what material is used for a filtrate, there is a limit to its usefulness. The best filters are made from animal charcoal well pressed together, so that the water must pass through the coal or magnetic carbide of iron. For purifying fresh water that is void of sewage deposits, about fifteen inches of fine washed, clean, sharp sand and twenty inches of gravel will make a suitable filter, if the top layer is removed and clean washed; then spread on again about once each week. This will make the water of a bright color and pure. If I were to build a filter on a large scale I should have a graded concrete bottom, so that the water on escaping from the filtrate material would come together and form a stream to enter the distribution pipes. I would then have a false grated bottom, bearing on pillars, to hold the filtrate material. I would run the water to be treated over shallow troughs, the bottoms pierced with very fine holes, at a convenient elevation above the filter, so that all the water intended to be filtered would fall into the filter in a fine spray similar to a needle bath; falling a distance, say, of four feet, in the form of a fine spray, the water would be aerated. I would also make a good system of ventilation that would insure a strong current of air to be continually passing between the cemented and false grating floor at the bottom of the filter. The water should pass slowly through at a pressure of about two feet above the face of the sand.

When water is delivered to consumers the shut off tap, usually fixed in the sidewalk near the street line, should be of the screwdown pattern, with the valve working loose inside, so that when full open it would allow water to pass through toward the house, but it would not allow any to return back into the mains. The tap would have a double action; it would not only make a first class stop tap, but also a foot or check valve. This would prevent any fluid being forced or drawn into the street mains, and effectually prevent the return of hot and tainted water from water heating boilers, steam and range boilers, etc., which is at present very prevalent.

Lead water pipes when laid in the earth should not be near any metal, because a galvanic action will be produced; nor near an electric car line, for the electricity will damage the lead if the soil it lies in is damp and a good electric conductor. Nor should it be laid near any tile or other drain, because a leakage of water would find a downward way of escape, and could not be easily found; nor under any manure pile, or near dirt or filth of any kind, because when the water is motionless in the pipe it will absorb some of the foul gas thrown off from such filth through the lead coating, and become tainted. Lead is the handiest metal for small water pipes, because it can be easily bent to any angle. When damaged by frost or water hammer it is easy to repair without removal. When laid underground it will sink with the soil, stretch, or give and take a little without injury. On the other hand, when rigid iron is used it will break before bending, and if damaged a full length has to come out. It is very unfortunate that a chemical action sets up between pure soft water and lead, which poisons the water when it stands motionless in the pipe for a few hours, and thousands have been seriously injured in health by drinking and cooking with water poisoned in that way.

The water that poisoned the Louis Philip family, of Claremont, contained seven-sixteenths of a grain of lead per gallon, and the water taken from the same source had injured to various degrees thirty-four per cent. of the population of the town. Analysts differ as to whether water can be poisoned by passing through galvanized or zinc pipes or not. I am positive that distilled water can be injured by using galvanized vessels, and, if so, other water must be injured to a less degree. Black iron, specially made very strong and soft in nature, so that it can be bent easily, is the healthiest article for use for service pipes. Some of the means suggested for removing the evil and still using lead pipes for domestic water supply, are: 1. To line the lead pipe one-sixteenth of an inch thick with block tin. 2. To give the pipes a bituminous coating. 3. To boil the lead pipe before using in a strong solution of sulphur and soda.

THE WORKING OF SHEET ALUMINUM.

Now that the manufacturers of aluminum have reduced the price to such an extent that aluminum used in large quantities for replacing brass can be used as economically as this latter metal, it has occasioned a great many inquiries as to what the proper methods are for working it, both rapidly and economically. Some factories have maintained that although the relative price of aluminum and brass were the same, after taking into consideration the specific gravity of the two metals, it was impossible to work aluminum as cheaply as brass could be worked, for the reason that the machinery working the metal could not be operated as fast, etc. Anyone, however, who has gone carefully into this subject will find that this is not so, and that when it comes to performing machine work of any kind on the sheet metal, it can be done in all cases as cheaply as brass, German silver, or tin plate can be worked, and in some instances it can be worked cheaper.

It has often been said, and correctly so, that the alloys of aluminum compare with the pure metal about as brass compares with copper. No better illustration could be given than this, and so accustomed have many of the shops in this country become to working brass that they would find it difficult to work copper, but the majority of cases in aluminum are just the reverse; that is, the people who find fault in regard to the cost of working aluminum have in the majority of instances based their opinion on the cost of working the pure metal. And so it is in the manufacture of most of the fancy articles out of aluminum; it is no more advisable to use the pure aluminum than it would be to make a similar article ordinarily made of brass out of the pure copper. This fact is not fully appreciated, especially by the people using aluminum, because their first experience has been with the pure metal, and it is difficult to get them to make a change.

The great secret, if there is any, in working aluminum, either pure or alloyed, consists in the proper lubricant and the shape of the tool. Another great disadvantage in the proper working of the metal is that, when a manufacturer desires to make up an article, he will procure the pure metal in order to make his samples which, of course, is harder to work than the alloy. But the different grades of aluminum sheet which are on the market are so numerous for different classes of work that it might be advisable to consider them for a moment before passing to the method of working them.

The pure metal, to begin with, can be purchased of all degrees of hardness, from the annealed, or what is known as the "dead soft" stock, to the pure aluminum hard rolled. Then comes a harder grade of alloys, running from "dead soft" metal, which will draw up hard, to the same metal hard rolled; and still again, another set of alloys which, perhaps, are a little harder still when hard rolled, and will, when starting with the "dead soft," spin up into a utensil which, when fin-

ished, will probably be as stiff as brass. These latter alloys are finding a large sale for replacing brass used in all classes of manufactured articles.

To start with lathe work on aluminum, probably more difficulty has been found here, especially in working pure metal, and more complaints are heard from this source than from any other. As stated before, however, these difficulties can all be readily overcome if the proper tools and the proper lubricants are used, as automatic screw machines are now made so that they can be operated when working aluminum just as readily as when they are working brass, and in some cases more readily. To start with the question of the tool, this should be made as what is known as a "shearing tool," that is, instead of a short, stubby point, such as would be used in turning brass, the point should be lengthened out and a lot of clearance provided on the inside of the tool, so as to give the chips of the metal a good chance to free themselves and not cause a clogging around the point of the tool. A similar tool, for instance, as would be used for turning wood.

The best lubricant to be used would be coal oil or water, and plenty of it. The latter is almost as good as coal oil if enough of it is used, and with either of these lubricants and a tool properly made, there should be no difficulty whatsoever in the rapid working of aluminum, either on the lathe or on automatic screw machines.

To go from the lathe to the drawing press, the same tools here would be used in drawing up shapes of aluminum as are used for drawing up brass or other metals. The only precaution necessary in this instance being to use a proper lubricant, which in this case is a cheap grade of vaseline, or in some cases lard oil, but in the majority of instances better results will be derived by the use of vaseline. Aluminum is probably susceptible of deeper drawing with less occasion to anneal than any of the other commercial metals. It requires but one-third or one-fourth of as much annealing as brass or copper. When, for instance, an article which is now manufactured in brass, requiring say three or four operations before the article is finished, it would probably have to be annealed after every operation. With aluminum, however, if the proper grade is used, it is generally possible to perform these three operations without annealing the metal at all, and at the same time to produce a finished article which to all intents and purposes is as stiff as an article made of sheet brass.

Too much stress cannot be laid on the fact of starting with the proper grade of metal, for either through ignorance or by not observing this point is the foundation of the majority of the complaints that aluminum "has been tried and found wanting." If, however, it should be found necessary to anneal aluminum, this can be readily accomplished by heating it in an ordinary muffle, being careful that the temperature shall not be too high—about 650° or 700° F. The best test as to when the metal has reached the proper temperature is to take a soft pine stick and draw it across the metal. If it chars the stick and leaves a black mark on the metal, it is sufficiently annealed and is in a proper condition to proceed with further operation.

Next taking up the question of spinning aluminum, again success depends particularly on starting with the proper metal. The most satisfactory speed for articles from five inches to eight inches in diameter is about 2,600 revolutions a minute, and for larger or smaller diameters the speed should be so regulated as to give the same velocity at the circumference. Aluminum is a very easy metal to spin and no difficulty should be found at all in spinning the proper grades of sheet. Several factories that are using large quantities of aluminum now, both for spinning and stamping, are paying their men by the piece the same amount as they formerly paid on brass and tin work, and it is stated that the men working on this basis make anywhere from 10 per cent. to 20 per cent. more wages by working aluminum.

After aluminum has been manufactured into the shape of an article the next process is the finishing of it. The best polish can be obtained by first cutting down the metal with an ordinary rag buff on which use tripoli, and then finish it with a dry red rouge which comes in the lump form, or that which is known as "White Diamond Rouge." One point, however, that it is necessary to carefully observe is that both the tripoli and the rouge should be procured ground as fine as it is possible to grind them; for, if this is not done, the metal will have little fine scratches all over it, and will not appear as bright and as handsome as it otherwise would.

If it is desired to put on a frosted appearance, this can either be done by scratch brushing or sand blasting. A brass wire scratch brush, made of crimped wire of No. 32 to No. 36 B. & S. gage, with three or four rows of bristles, will probably give the best results. This work of scratch brushing can be somewhat lessened, however, if, before applying the scratch brush to the surface of the aluminum, the article is first cut down by the use of a porpoise hide wheel and fine Connecticut sand, placing the sand between the surface of the aluminum and the wheel, so that the skin and the irregularities on the surface are removed, and then putting the article on a buffing wheel before attempting to scratch brush it. This method, however, is probably more advantageous in the treating of aluminum castings than for articles manufactured out of the sheet metal, as in the majority of cases it is simply necessary before scratch brushing to cut down the article with tripoli, and then polish it with rouge as already described, before putting on the scratch brush; in this way the brush seems to take hold quicker and better, and to produce a more uniform polish.

An effect similar to the scratch brush finish can be got by sand blasting, and by first sand blasting and then scratch brushing the sheets, a good finish is obtained with very much less labor than by scratch brushing alone. Another very pretty frosted effect is procured by first sand blasting and then treated as hereinafter described by "dipping" and "frosting," and many variations in the finish of aluminum can be got by varying the treatment, either by cutting down with tripoli and polishing, scratch brushing, sand blasting, dipping and frosting and by combinations of those treatments. A very pretty mottled effect is secured on aluminum by first polishing and then scratch brushing and then holding the aluminum against a soft pine wheel, run at a high rate of speed on a lathe, and by careful manipulation quite regular forms of a mottled appearance can be obtained.

The dipping and frosting of aluminum sheet is probably the cheapest way of producing a nice finish. First remove all grease and dirt from the article by dipping in benzine, then dip into water in order that the benzine that adheres to the article may be removed, so as not to affect the strength of the solution into which it is next dipped. After they have been taken out of the water and well shaken, the articles should be dipped in a strong solution of caustic soda or caustic potash, and left there a sufficient length of time until the aluminum starts to turn black. Then they should be removed, dipped in water again, and then into a solution of concentrated nitric and sulphuric acid, composed of twenty-four parts of nitric acid to one part of sulphuric acid. After being removed, the article should be washed thoroughly in water and dried in hot sawdust in the usual way. This finish can also be varied somewhat by making the solution of caustic soda of varying degrees of strength, or by adding a small amount of common salt to the solution.

In burnishing the metal use a bloodstone or a steel burnisher. In burnishing use a mixture of melted vaseline and coal oil, or a solution composed of two tablespoonfuls of ground borax dissolved in about a quart of hot water, with a few drops of ammonia added. In engraving, which adds materially to the appearance of finished castings, book covers, picture frames and similar articles made of sheet, probably the best lubricant to use on an engraver's tool in order to obtain a clean cut, which is bright, is naphtha or coal oil, or a mixture of coal oil and vaseline. The naphtha, however, is preferred, owing to the fact that it does not destroy the satin finish in the neighborhood of the cut, as the other lubricants are very apt to do. There is, however, as much skill required in using and making a tool in order to give a bright, clean cut as there is in the choice of the lubricant to be used. The tool should be made somewhat on the same plan as the lathe tools already outlined. That is, they should be brought to a sharp point and be "cut back" rather far, so as to give plenty of clearance.

There has been one class of work in aluminum that has been developed lately and only to a certain extent, in which there are great possibilities, and that is in drop forging the metal. Recently some very superior bicycle parts have been manufactured by drop forging. This can be accomplished probably more readily with aluminum than with other metals, for the reason that it is not necessary with all the alloys to work them hot; consequently they can be worked and handled more rapidly.—The Aluminum World.

THE MANUFACTURE OF RUBBER SUBSTITUTES.

SUBSTITUTES enter very largely into the compounding of rubber, because of certain distinct advantages which they possess and which are not shared by coal tar or the simple mineral adulterants. They have not the vulcanizing effect of sulphur or the metallic oxides and sulphides. Their chief value lies in cheapening the stock without disturbing its working qualities or impairing the texture, finish or weight of the manufactured product. Their after effect on the life of the goods is, however, another matter.

The term rubber substitute may be broadly considered as including any substance possessing characteristics similar to those of unvulcanized rubber and adapted to displace it in compounding. Ordinary reclaimed rubber, as well as the sulphurized oils, are included in this definition.

The reclaimed rubber of commerce is obtained by steaming or devulcanizing old rubber waste, generally shoes, freed more or less perfectly from fiber. Having originally contained some real caoutchouc, it is generally considered rubber of low grade rather than rubber substitute. Since its introduction its use has rapidly extended, until it is now a very essential factor in the ordinary and cheap lines of goods and its presence is not entirely unknown even in the highest grades. As a substitute it ranks first in merit and general use; the annual output in this country alone reaching thousands of tons.

As a substitute it is most available in goods where color or extreme lightness are not essentials. Being chemically inert, that is, free from any oxidizing tendency, it can be compounded with rubber in all proportions without injury to the new stock.

The sulphurized oil substitutes constitute a class by themselves and are distinguished as brown or white, although chemically they are essentially very similar. Any of the readily oxidizable, vegetable or drying oils combine freely, under proper conditions, with sulphur to form a more or less rubberlike mass. According to the selection of the oil and the mode of treatment, we get brown or white substitute. Such oils as linseed, rape, mustard and peanut are well adapted to make brown substitute. The process is a simple one, consisting in boiling any one of these oils or mixture of them in any proportion with flowers of sulphur. The operation may be carried on over a fire or by steam in a jacketed kettle. The proportions are generally about eighty per cent. of oil and twenty per cent. of sulphur. The reaction is complete in three or four hours at the heat of steam at a pressure of eighty pounds (325° F.)

It is well to boil the oil out of doors or in a strong draught of air to carry off the noxious vapors. The mixture should be thoroughly stirred while cooking.

Mustard oil reacts quite promptly with sulphur, but gives a firmer product and one that breaks rather shorter than that from the other oils named. It is best used in mixture with them. Linseed gives off the most disagreeable odor and has no special advantage in point of quality of product.

The white variety of oil substitute is made by treating refined mustard, rape, castor or cocoanut oils separately or in mixture with sulphur chloride either in the cold or with moderate heat.

The light, porous variety may be made by mixing with the oil a small proportion of sodium bicarbonate, which, under the influence of the sulphur chloride, generates gas in sufficient quantity to render the whole mass very spongy.

The operation should take place in an earthen or lead lined vessel and the sulphur chloride added slowly and stirred briskly into the oil.

The proportion of sulphur chloride to oil should be about one to eight, and of soda to oil about one to twelve.

When the chemical action is over, the product is allowed to dry for a couple of days before use.

A solid amber colored substitute is made in the same way and proportions, omitting the sodium bicarbonate.

All operations involving the use of sulphur chloride should be conducted in a strong draught and best in the open air, to avoid the evil effects of the vapors.

Chemically the use of these sulphurized drying oils in rubber compounds is bad. They exert a marked influence in shortening the life of the goods, because, by their active chemical nature, they hasten the oxidation of the rubber present to the brittle resinous products which give evidence of their existence in the compound by its loss of elasticity and by the hardening and cracking of the surface. There is little to be said for these oil substitutes from a chemical point of view. Their great practical value is entirely a matter of price, for they enable the manufacturer to cheapen the stock while maintaining the proper relative weight or specific gravity of the compound with reference to pure rubber.

The matter of specific gravity, or the ratio of the weight of any substance to that of an equal volume of some other substance taken as a standard, is a point of much importance. It governs the relation of pound price and piece price in rubber manufacture.

Specific gravity and the percentage of ash in a rubber compound once gave an indication of the amount of rubber present, but, since the extensive use of oil substitutes, they have no value as specifications of quality.

The specific gravity of caoutchouc or pure unvulcanized rubber is 0·915. It will therefore float in water about like ice, that is, nearly submerged. The oil substitutes are slightly heavier; enough so to sink in water.—India Rubber World.

ACETYLENE ON BOARD SHIPS.

ACCORDING to the Gas World, "Acetylene Gas and Its Probable Future Afloat" was the title of a lecture that Prof. Vivian B. Lewes delivered before the Institution of Naval Architects, on Thursday, April 8. Having briefly described the discovery and properties of commercial calcic carbide and acetylene, Prof. Lewes proceeded to discuss methods by which the latter might be applied on board ship. He said that the possibility of liquefying acetylene at pressures about those at which liquid carbon dioxide was produced so largely enabled considerable volumes of the gas to be compressed in the liquid state in small wrought iron or steel cylinders, and that it was in this liquefied condition that the gas would have to be utilized on board ship. At the freezing point, liquid acetylene would give about 370 times its own volume of gas. The pressure which liquid acetylene exerted upon the cylinders containing it varied with the temperature, but for all ordinary degrees of heat—say, from 60° to 75° F. —the pressure would be from 600 to 700 lb. on the square inch, while when heated to 86° F. the pressure rose to 1,000 lb. The cylinders, however, were generally tested to two or three times this pressure, so that there was an ample margin of safety.

During the past two years there had been two or three explosions caused by cylinders of liquefied acetylene, and these had given rise to a feeling that acetylene in this form was not safe; but it must be remembered that the introduction of a compound of this description, with comparatively unknown properties, must for a considerable period be hampered by accidents caused by improper usage; and there was proof that in each of the accidents that had occurred the screw plugs closing the cylinders were being tightened up with undue violence.

The Factor of Danger.—The factor of danger in liquid acetylene, and also in the compressed gas, was that acetylene was an endothermic compound, i. e., a compound in the formation of which heat is absorbed, instead of, as is usually the case, being liberated; and with such compounds this heat was again set free when they underwent decomposition, and added considerably to the violence of the action. At any pressure up to two atmospheres acetylene was perfectly safe from any explosive action per se, as at these low pressures high temperature, or even the detonation of a charge of mercuric fulminate in the gas, only caused local decomposition, and the explosion did not travel for more than a few inches from the spot where it was started; but directly the gas was put under more than two atmospheres pressure a red heat would initiate explosion through the whole volume, this being due to the sudden resolution of the acetylene into its constituent elements, carbon and hydrogen, with the liberation of the endothermic heat stored up in it. This all sounded very alarming, but when the conditions of danger were realized it was at once evident that, with rational treatment, cylinders of liquid acetylene were for all practical purposes perfectly safe, as, when kept in water tanks, nothing short of the surroundings being on fire would give the requisite temperature to cause danger, and on board a vessel the cylinders could easily be dropped overboard on a line until such danger had passed.

For Buoys and Lighthouses.—When it was considered that a cylinder holding 1 cubic foot of the liquefied gas would supply a burner giving a light of 32 candles for 400 hours, it was evident that there were great possibilities for it in the future on ships and yachts not fitted with the electric light. With a proper and special arrangement, highly efficient gas engines could be driven by it, and in small atmospheric burners it gave a flame of very high temperature; so that it was by no means impossible that the twentieth century might see a high speed torpedo boat driven by an acetylene engine, with an acetylene search light and an acetylene cooking stove, while some might even add to the equipment an acetylene torpedo, as a most effective "Sprengel" explosive might be made from liquid acetylene and chlorate of potash. These were dreams of the future, but there were certain spheres of utility ready for acetylene in which no plea of danger could be urged against its adoption. The first of these were floating buoys. At the present time there were four methods by which these could be lighted: 1. Electricity, 2. Compressed oil gas, 3. Com-

pressed coal gas enriched by gasoline. 4. Wigham's oil lamps. With electricity, the chance of the conducting wires being fouled by an anchor or dredge always existed; the compressed oil gas needed a small gas works and compressing plant; compressed coal gas and gasoline enrichment demanded the latter if not the former; while Mr. Wigham's oil lamps stood out as being both good and economical. There was room, however, for acetylene for this purpose, and a cylinder of liquid acetylene having a capacity of 1·75 cubic feet, fitted with a reducing valve, and stored in the bottom of the buoy, would give a clear white light of 32 candles for one month, and in cost would even now be about equal to compressed oil gas giving the same amount of light. If legal restrictions should prevent liquid acetylene becoming a commercial commodity, then compressed acetylene gas in cylinders, of the Pintsch or Pope pattern, could be effectively used, the gas giving a candle power three times as high as the best freshly pumped oil gas. For such purposes as buoy lighting and for use in lightships, the cylinders of liquefied acetylene seemed to be especially adapted, while the still more important function of an auxiliary light for use in lighthouses would be best carried out with the uncompressed gas. For lighthouse use the apparatus would be so rapid in action that, even with the holder empty, gas could be made and the lantern burning within a very few minutes of the breakdown of the electric apparatus.

Penetrative Power.—Prof. Lewes next spoke of the penetrative power of different lights, remarking that the usefulness of a light for signaling purposes depended upon its power of passing through the atmosphere without change or absorption. Measuring the penetrative powers of different lights by means of a cell containing an artificial haze, he obtained the following data, the figures being the percentage of light lost in passing the cell:

Coal gas	11·1
Oil gas	11·5
Acetylene	14·7
Incandescent gas (Welsbach)	20·8
Electric arc	26·2

Of course, these figures merely give the loss of light in passing through the thickness (3 in.) of fog solution employed; but it was evident that they would also give approximately the ratio of the penetrative power of these illuminants in mist-laden air.

Automatic Lights.—A minor, but, at the same time, very important, use to which calcic carbide could be put was in the manufacture of signal lights of the same character as the Holmes lights now in use. He had come across several specimens of carbide of Continental manufacture which gave acetylene spontaneously inflammable in air. On investigating this phenomenon he found that it was due to the carbide containing a certain proportion of calcic phosphide, which, on contact with water, gave enough spontaneously inflammable phosphureted hydrogen to ignite the acetylene. It naturally occurred to him that this might be utilized in making very valuable signal lights, of the same character as Holmes lights, for indicating the position of life belts, torpedoes, etc., as if the Holmes cartridge were filled with a mixture of calcic carbide and phosphide, only a small proportion of the phosphide served to make the acetylene, rapidly evolved on contact with water, ignite on coming in contact with air, and the light-giving power of the flame was far more effective than that emitted by the phosphide alone. Moreover, the cartridge could be made in the form of a hollow tube, so weighted as to float with its open end downward; and if a small cage of the mixed carbide and phosphide were fixed in the upper portion, and a tube with a small burner let into the top of the cartridge, the gas escaping spontaneously lighted, and burned with a flat flame of such intensity that it could be seen for a very great distance. He should imagine that if such a candle were attached to the life buoys, flung overboard at night, it would not only guide a swimmer to the buoy, but also mark the direction in which the ship's boats had afterward to proceed.

THE MECHANICAL SHIPMENT OF COAL.

The continual increase in the production of coal mines, along with the extension given to carriage by water, has led to an improvement of the methods usually employed for the shipment of the coal. Mechanical processes are the only ones that permit of rendering this operation both rapid and economical. For this reason, numerous solutions of the question have been proposed, and the systems employed at the mines almost always vary from one exploitation to another.

The most frequent process consists in the use of cars whose boxes are jointed upon their frame and are capable of tilting to one side. This is a very simple solution, but it requires a motive power and an installation of special lifting apparatus.

At the mines of Lens cranes are installed upon the locomotives, while in other exploitations the tilting motion is effected through a compressed air apparatus somewhat similar to the brake apparatus in use upon railway lines and which the engineman can maneuver from the locomotive.

The idea has occurred to do away with the use of these lifting apparatus by adopting cars similar to those used for carrying filling material upon the Panama Canal. The box of these cars was likewise jointed to the frame, but its center of gravity projected with respect to its suspension point. A bolt held the box in its ordinary position, and as soon as it was drawn, the tilting motion took place under the action of gravity.

The saving that this arrangement seems to afford is illusory, since, although it does away with the use of lifting apparatus, it thereby necessitates an increase in the dead weight of the cars in order to have a frame that shall remain in perfect equilibrium upon the rails at the moment that the box of the car is tilted. Consequently, the cost of hauling the cars from the mine to the shore is largely increased.

Besides, this system presents another inconvenience, and that is that the tilting motion is not uniform, but, on the contrary, gives rise to an inevitable acceleration, with the result that the load is dumped quite abruptly, the coal is broken in small pieces, and the proportion of waste is increased.

An endeavor has also been made to effect the shipment by means of a sort of seesaw, that is, of a board pivoting upon an axis and giving the cars a sufficient inclination to allow the coal to slide into a loading hopper. These apparatus, which were hydraulic, and consequently necessitated a special motive power, were in favor for a long time. We believe it of interest, from this view point, to make known the arrangement devised by M. Malissard-Taza, superintendent of Madam Taza-Villain's works at Anzin, since it permits of dispensing with the use of an external motive power, the apparatus operating simply under the action of the weight of the car to be discharged. This very ingenious arrangement consists of a metallic platform, F, oscillating around two journals, and upon which the car to be dumped is so placed that its center of gravity shall be eccentric with respect to the journals. A piston, P, working in a cylinder, C, completely filled with water, is connected with the platform by its rod and a jointed connecting rod, B, whose extremity is fixed on the opposite side at the center of gravity of the car with respect to the axis of the journals.

The upper and lower parts of the cylinder communicate through a conduit of small diameter provided with a cock, R. Beneath the platform, a pendulum composed of two counterpoises is so suspended that its center of gravity shall be in the same vertical plane as the axes of the journals.

After the car has been placed upon the platform it is held firmly at its two extremities and then tends to cause the platform to tilt; but, since the cock, R, is closed, the piston, in consequence of the incompressibility of the water contained in the cylinder, prevents such motion. As soon as the engineman opens the cock by means of the system of levers, L, he allows the water contained in the upper part of the cylinder to escape. This flow may, moreover, be easily regulated by a maneuver of the cock so as to render the tilting motion as slow as may be desired. The action of the counterpoises, which was null at first, keeps on increasing in measure as the inclination becomes greater. This pendulum therefore serves as a moderator.

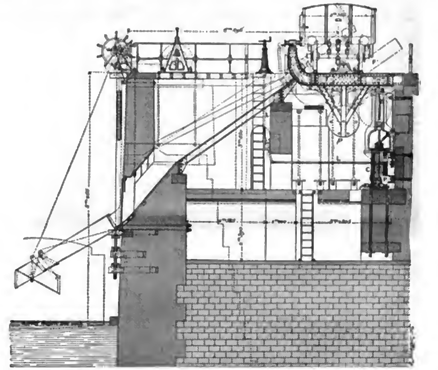

Fig. 1.—DIAGRAM OF THE MALISSARD-TAZA INSTALLATION FOR THE SHIPMENT OF COAL.

The doors of the car are movable around a horizontal axis situated at the highest part of the box, and, as soon as the latter begins to incline, they tend to open through their own weight and the thrust of the load; but they are kept closed by a bolt that is not withdrawn until the platform has reached the maximum inclination of 38°. At this moment the coal slides gently into the hopper. The return of the empty car to its horizontal position is determined by the action of the pendulum, and this motion is regulated likewise by the hydraulic brake.

The hopper into which the coal falls is in two parts, one of them fixed and the other movable. The former has quite a feeble inclination that renders the sliding of the coal easy and free from shock, and the other part can be easily maneuvered, and permits of distributing the coal in all portions of the boat.

Fig. 2.—MECHANICAL SHIPMENT OF COAL.

This installation is completed by an apparatus for towing by manual power. This consists of a windlass around which winds an endless steel cable. Upon connecting this cable with the boat, it is possible to move the latter in two directions by maneuvering the windlass.

This apparatus, which is constructed for 10 ton cars,

permits of the shipment of from 20 to 25 car loads an hour, that is to say, of from 2,000 to 2,500 tons of coal per day of ten hours. It requires but two men for the operation.—La Nature.

ENDOSCOPY.

DURING the few months following the discovery of the X rays it was necessary to use a photographic plate in order to obtain the image of an object invisible to the naked eye. Since then, Edison, Salvioni

FIG. 1.—DUCRETET & LEJEUNE'S ARRANGEMENT FOR THE TREATMENT OF TUBERCULOSIS BY X RAYS.

and many others have substituted for the sensitized plate a fluorescent screen that permits the human eye to see the interior of the body as easily as if the corporeal envelope were as transparent as glass.

In Italy, along about 1600, a peasant having calcined a stone, perceived that it emitted a light in darkness after it had been exposed to sunlight for some time.

This was, as now known, sulphate of baryta, which had been converted into sulphide of barium by calcination. Chemistry afterward found other bodies that are possessed of these curious properties, such as sulphide of zinc, platinocyanide of potassium, tungstate of calcium, etc. All these bodies possess, to a different degree, the singular property of emitting luminous radiations in darkness without their temperature differing from that of the surrounding medium. The ultra-violet radiations of light produce a marked action upon phosphorescence. The X rays possess the same property to a high degree.

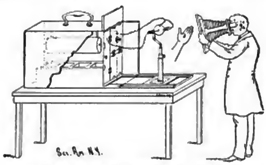

FIG. 2.—M. SEGUY'S APPARATUS IN OPERATION

Now, it will be recalled that it was owing to some paper covered with platinocyanide of barium that happened to lie near a Crookes tube that Dr. Roentgen discovered the X rays.

There have therefore been constructed screens formed of a wooden frame upon which is stretched strong paper covered with a chemical substance capable of becoming fluorescent under the action of the X rays. Upon interposing between this screen and the tube that produces the rays an object opaque to the eye, it becomes immediately visible upon the prepared surface. Thus, for example, if one puts his hand between the two objects, it at once disappears and nothing but the bony skeleton is perceived.

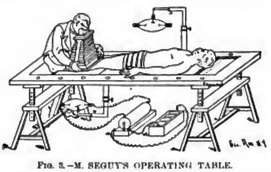

FIG. 3.—M. SEGUY'S OPERATING TABLE.

The consequences and advantages of this valuable observation will be at once seen. A patient may be "visited," without any trouble or suffering on his part.

It is now possible, by employing electric currents of varying strength, according to circumstances, to witness the beating of the heart, the inflation of the lungs, and the motions of the diaphragm, and to perceive the liver, the spleen and the different glands. As for the bony framework, that has no longer any secrets. The apophyses and the articulations stand out with wonderful distinctness and the slightest osseous traumatisms are revealed much better than with percussion and auscultation.

Certain affections of the bladder and aorta are discovered by means of this new method of investigation. Finally, the lesions of the lungs in consumptives are likewise observable, and this terrible disease will, perhaps, be cured by the action of the X rays. Numerous observations have already been made by Profs. Lortet and Genoux, of Lyons, and by Drs. Vilain, Rendu, and Du Castel, of Paris. It really seems as if an evident action took place in tuberculous subjects and those afflicted with infectious diseases. Moreover, it is unquestionable that prolonged radiations produce upon the skin a rubefaction analogous to that which would be produced by a strong insolation or a sinapism.

Since the entire thickness of the body is traversed, such action must not be external merely, and the subcutaneous walls have a marked sensitiveness. The action of the X rays appears to destroy the toxines secreted by microbes, and which are the cause of the disease above indicated. It is so certain that therapeutics will make use of this method that special apparatus are already constructing, such as those represented in Figs. 1, 2 and 3. The first figure shows the arrangements made by Messrs. Ducretet and Lejeune, for the treatment of affections of the chest. The other apparatus, which were devised by Engineer Seguy, are designed to facilitate all radiographic operations (taking of photographs) or radioscopic ones (vision with a fluorescent screen). Fig. 3 shows a patient lying upon a special operating table. The center of this table is hollowed out, and, through grooves, permits of sliding in negative frames containing sensitized photographic plates designed to remain as a witness in discussed and difficult cases. In more general cases, the diseased member is examined with a sort of opera glass, which contains the fluorescent screen. This glass permits of observing in broad daylight. It forms part of a very simple apparatus inclosed in a box containing the accumulators, the Crookes' tube and the transformer (Fig. 2).

It happens, and more frequently than might be thought (as clinics can prove), that certain bodies enter the organism in an accidental way—coins into the œsophagus, pins and needles into the hand or foot, projectiles from firearms into the body, etc.

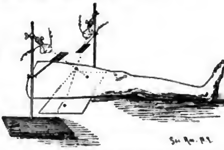

FIG. 4.—BRUNEL'S ARRANGEMENT FOR LOCATING FOREIGN BODIES IN THE HUMAN ORGANISM.

Formerly, the exploration in order to locate such bodies was a lengthy and painful operation. Thanks to the X rays, and to the following arrangement devised by the writer of this article, the place of the object is at once indicated without any suffering on the part of the patient. Say, for example, that a revolver ball has entered the thigh. The wounded member is arranged as shown in Fig. 4. Two Crookes tubes are placed above small glass or metal diaphragms and a photographic plate is placed beneath the member. Upon the plate we shall therefore have a projection of the ball at two different places. The shadows will be projected at AB and A B (Fig. 5). We shall have the images at

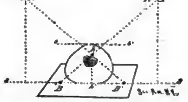

FIG. 5.—GRAPHIC DETERMINATION OF THE POSITION OF A FOREIGN BODY.

BB'. It will only remain to measure the distance of the tubes, AA', and to transfer such measurement (all proportions being kept) to a sheet of paper, as shown in the diagram. The height, h h, of the triangle BhB', measured from h to h, will give the exact situation of the foreign body, e, in the part, O, or its distance to the tangent line, s s'.

It may happen, also, that it is desired to radiograph a definite portion of an organ and that it is difficult to know the exact time that it will require to take the part desired. By means of my "doseur" all tentative efforts are avoided. This apparatus is very simple. It consists of a metal plate provided with five apertures, A B C D E, four of which may be closed by means of a shutter of the same metal.

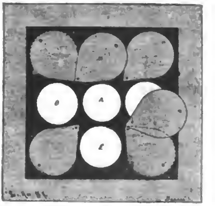

FIG. 6.—THE BRUNEL DOSEUR.

The plate may be surrounded with a wooden frame. When it is desired to obtain an image of a certain organ, a radiographic operation is first performed. The doseur is arranged beneath the Crookes tube in opening all the apertures, and an exposure is made for a fraction of a determinate time. One shutter is then closed and another exposure is made for the same length of time,

and one continues thus until the four apertures are closed. When the operation is finished, the part, A, will therefore have made an exposure five times longer than the first aperture, and the others in proportion. The plate having been developed, we shall have five very distinct circumferences upon the negatives. We shall then see, according to the part most conspicuous, the exact time that must be taken to obtain an image of the organ designated. This preliminary operation will not prove a loss of time, since otherwise we should be obliged to take three or four negatives before obtaining a good result. All those who have experimented with X rays up to the present know this well.

Among all the operations that have been performed by means of the X rays, I shall mention but one, and that an extremely interesting one. A patient who was diabetic to the last degree, and who dreaded the smallest surgical operation that might bring on a flow of blood, had a piece of a needle in his foot that prevented him from walking, and of which it was necessary to rid him through the extirpation of the metal.

Dr. Niquet and M. Radiguet tried the following operation. They located the exact position of the needle by means of radioscopy, and then endeavored to attract it by means of a powerful electromagnet. In two operations of one hour they succeeded in extracting the piece of metal without drawing a drop of blood.

At present, astonishing operations that no one would have dared to attempt a few months ago are daily performed in clinics by means of the X rays.

But although X rays are used, the nature of them is not as yet known. Are they cathodic rays formed in the interior of the tubes and a portion of which alone passes through the glass? Is it the glass rendered fluorescent under the action of these rays that emits the X rays? Finally, is it a peculiar electric phenomenon?

These are the questions that confront those scientists who are occupying themselves with this obscure subject.

However, every day introduces a new element into the observations. Thus, M. Radiguet has observed in his laboratory an order of phenomena that are mysterious and confusing to the uninitiated when they pass

Fig. 7.—PHENOMENA OF LUMINESCENT CRYSTALS DISCOVERED BY M. RADIGUET.

into the darkness. The tube that produces the radiations being well wrapped in black cloth, and the darkness being absolute in the laboratory, all the crystals, glasses, gas globes and electric light bulbs are seen to become gradually illuminated. This seems like magic. If we take a glass provided with facets, the effect is wonderful. If the glass be moved about, the arm and hand being invisible, it will seem as if the glass is moving of itself without being held, and the same is the case with all glassware. It is weird and mysterious. Porcelain, enamels and brilliants also have the property of becoming illuminated under the action of the X rays. The luminous phenomenon becomes less marked at a distance, and this is perhaps the reason why it had never been observed up to the present.

What is the cause of this luminosity? It may be said that under the action of the X rays the molecules of the glass change state and emit ultra violet rays. Now, aside from sulphate of soda, glass contains at least a certain quantity of silicate of baryta. May it not be this substance, incorporated with the glass and converted by heat into sulphide of barium, that emits the fluorescence? However this may be, M. Radiguet's observation is interesting in more than one respect. It offers a new road to researches and to practical applications that were immediately seen by its author; for example, the re-enforcement of photographic action upon sensitized plates and the construction of opera glasses and eye glasses that emit no light and that constitute X ray glasses, which are very useful to operators.

Although, then, the mystery that hovers over the identity of the X rays still exists, the numerous and beneficial applications that are made of them are capable of consoling scientists and investigators for not having made a step in the way of solving this new problem in physics laid before them by the celebrated professor of Wurzburg.—G. Brunel, in La Revue des Revues.

On May 30, the Swiss sections Tug-Golden and Luzern Immensee on the Berlin-Milan line were opened. The result is a shortening of the journey by one hour and the leading of the line through more picturesque surroundings.—Uhland's Wochenschrift.

THE COLOR OF BLOOD.*

By Felix Oswald, B.A. Lond.

"Blood red" is so familiar an adjective of color as to readily convey the impression that the blood of all animals is red. Such, however, is far from being the case, for although the possession of red blood is a characteristic common to all vertebrates,† yet when we come to examine the invertebrates, which are far more numerous both in species and individuals, we find that blood of a red color is a relatively rare occurrence. In the majority of cases it is colorless; but it may be even green, blue or yellow.

It has often been a subject for speculation why the life fluid of higher animals should have so vivid a hue, seeing that it is normally concealed from view, and seldom or never plays any part in determining the surface coloration, excepting in a blush. It is only a partial explanation to say that the redness is due to hæmoglobin, and that it is an inherent physical characteristic of this body. The reason for the red color is quite as difficult to explain as to account for the distinguishing colors of gold, silver or copper. It is no exaggeration to say that hæmoglobin is the most important substance in the complex combination called blood, for it is hæmoglobin which absorbs oxygen from air or aerated water, conveying it to all tissues in need of that vital gas, receiving carbon dioxide in return, and finally giving up the excess of this waste product of combustion to the surrounding medium. Hæmoglobin can be artificially separated from blood to form crystals, differing in shape according to the animal.

Usually, as in man, they take the form of prismatic needles or rhombic plates. It can furthermore be resolved into hæmatin, a dark brown amorphous powder, and an albuminous substance called globulin. Under the spectroscope it exhibits a very characteristic absorption spectrum,‡ by means of which Lankester and others have been able with absolute certainty to demonstrate its presence in the blood of certain invertebrates.

The hæmoglobin in the blood of vertebrates is contained exclusively in little circular disks,§ the red corpuscles. In the few instances in which it occurs in invertebrate animals, it is generally diffused in the plasma, e. g. in the blood of the earthworm and many other Chætopod worms, in some leeches (the Gnathobdellidæ), in some Nemertine worms (e. g. Polia), in the fresh water mollusk Planorbis, in a few small crustaceans (Cheirocephalus and the water flea Daphnia) and in the so-called bloodworm (the larva of the midge, Chironomus). Less frequently it is found concentrated in corpuscles, e. g. in the bivalve mollusks, Solen legumen and Arca noæ, in a few Chætopod worms (e. g. the Polychæta Glycera and Capitella), in some Gephyrean worms (Phoronis, Thalassema, Hemingia), in some Nemertine worms (e. g. Cerebratulus) and in a few Echinoderms (Thyonella, a sea cucumber, and Ophiactis, a brittle starfish).

These examples occur sporadically among such widely separated groups of animals that hæmoglobin must evidently have been independently acquired several times in the animal kingdom. It is clear that the possession of it does not in itself indicate any relationship.

Arterial blood is scarlet owing to the hæmoglobin containing a rich supply of oxygen; on the other hand, the dark purple color of venous blood is due to an excess of carbon dioxide. Both gases, however, are present in arterial as well as in venous blood; indeed, the former actually contains more carbon dioxide than oxygen. The difference in color, therefore, is merely a question of varying proportion, for an artificial solution of hæmoglobin changes color from purple to scarlet when a current of oxygen is passed into it. It is indeed probable that the oxygen enters into a state of unstable chemical combination with the hæmoglobin, and that the red corpuscle does not merely hold it as a sponge.

In this way the presence of hæmoglobin is an absolute necessity for the more remote internal parts of the body to receive a due supply of the vivifying oxygen and to get rid of the waste carbon dioxide. Indeed, it is doubtful whether vertebrates could have reached their great size and dominant position in the world without the possession of hæmoglobin in its valuable capacity for storing up oxygen. Hæmoglobin, however, is not confined to blood, but is contained in the voluntary muscles of the higher vertebrates (hence the red color of raw flesh) as well as in the tissue of the heart. Among fishes, however, it is entirely absent from the muscular tissue of the body, excepting in the fin muscles of the graceful little sea horse (Hippocampus). Among invertebrates it is found in the muscles of the pharynx of a few mollusks (Chiton, Patella, Littorina, Paludina, Lymnæus and Aplysia), but strange to say, not in the blood of these creatures. In the Chætopod worm, the sea mouse (Aphrodite), it is even restricted to the nerve centers.

In reviewing the habits of those invertebrates which possess this valuable colored substance, we are able to infer that either (1) they show increased activity compared to their nearest relations, as in the case of the Neapolitan razor shell (Solen legumen); or (2) they live under circumstances in which oxygen is not easily obtained, as in the case of the bloodworm in the mud of stagnant pools, etc.; this is probably the main cause, and the power of being able to store up oxygen, whether in blood, muscle or nerve, must be a valuable aid in such adverse conditions; or (3) there may be a combination of these reasons, as in the leeches, which inhabit miasmic localities and yet show great activity, leaping upon any unfortunate man or animal invading their marshes. In the case of the bloodworm, Professor Miall has shown that it could live as long as five days in water that had been deprived of its oxygen by boiling.

The view that hæmoglobin has been primarily acquired merely as an expedient in conditions unfavorable to easy respiration is supported by the fact that the insect Chironomus possesses it only in its larval (bloodworm) stage, but when it reaches its final and winged state its blood is colorless. The disappearance of hæmoglobin in the blood of the perfect insect is indeed a highly remarkable fact; yet it is not surprising when we consider how thoroughly air is distributed to every tissue in an insect's body through the air tubes or tracheæ. The excessively delicate ramifications of these tracheæ extend into every muscle and even penetrate between the cells of the eye and of the nerve centers; hence, since every part of the body has direct access to the oxygen of the air, there is no need for this gas to be conveyed by the blood; consequently the circulatory system in insects is very imperfectly developed, and the blood is colorless.

Hæmoglobin does not, however, stand alone in the animal kingdom in its function of storing up oxygen. In the blood of certain tube-forming worms (Sabellidæ and Serpulinæ) a greenish substance, chlorocruorin occurs which has similar powers of absorbing oxygen and yielding it up to all parts of the body in need of it. It is, therefore, within the range of possibility that if the ancestor of the vertebrates had developed chlorocruorin in its blood in preference to hæmoglobin, our blood might be green, instead of red, and our admiration aroused by a verdant instead of a pink complexion.

* From Science Gossip.

† There appear to be only two exceptions to this rule, viz., the lancelet (Amphioxus), which is the lowest vertebrate, and the transparent little fish Leptocephalus, now regarded as the larval stage of the eel.

‡ It is interesting to note, as Prof. Church points out, that hæmoglobin possesses the same conspicuous absorption band in the ultra violet as chlorophyl, although, of course, the rest of the spectrum is very different.

§ Elliptical in fishes, amphibians, reptiles, birds and in the camel family. In the lampreys, however, the red corpuscles are circular.

MACHINE TO LOCATE FIRES.

Although the city of Vienna has an up-to-date fire alarm system, there is, however, constantly maintained a fire watch of several men on duty at all times in the tower of St. Stephen's Cathedral, the highest point in the city. For the purpose of locating a fire, there is in use a novel instrument known as the "topescope," which is said to do its work in day or night with unerring accuracy, says the Boston Journal of Commerce. The topescope consists of a good telescope, which is solidly attached to an arrangement of levers, while graduated sections of a circle are arranged horizontally and vertically in such a way that the moving of the telescope sideways or up and down results in a change of position of the hands attached to the levers in reference to the graduated scales. It is obvious, the stability of the apparatus being assured by their being firmly fastened, that whenever the telescope is focused upon the same object the hands will point to the same figures on the horizontal and on the vertical sextant, and, since an index of the whole city has been made, it is a matter of but a few seconds when a fire is discovered at night to direct upon the spot the topescope on the respective side, to read off the numbers, to look up the object and to wire it to the central fire station, with all the details observed. Local conditions are, of course, necessary for the successful operation of this apparatus, but in this case they are almost perfect. St. Stephen's tower is over five hundred feet high; the great area of the city is situated in the broad valley of the Danube, allowing an uninterrupted panorama to the city limits. The atmospheric conditions are also favorable. The topescope up there works so accurately that even at night the exact house and number were often given to the central by the watchman on the tower, while the next fire alarm box, being at a distance of three or four blocks, could not have given the exact location of the fire, and this would have delayed the arrival of the fire department accordingly.

The Sanitary Trustees of Chicago will build the largest swing bridge in the world across the drainage canal at Thirty-first Street and Campbell Avenue. Its total length will be 400 feet 5 inches, and its width will be 120 feet. The height of the center columns will be 98 feet; headway under the trusses for trains, 21 feet; headway under the bridge, 18 feet; and depth of water in the channel, 24 feet. The bridge will be of steel, weighing 7,000,000 pounds. It will be capable of supporting a train load of 8,000,000 pounds. The total cost is estimated at $700,000, including the machinery. Three railways will use the structure, crossing on eight tracks. The turn table will have a diameter of 80 feet, and the bridge will be swung in one minute, probably by electric power.

ENGINEERING NOTES.

The first home-manufactured locomotive in Japan was built in 1892-1893.—Prometheus.

The municipal council of Berlin has just decided, by a large majority, that henceforth the trolley system is to supplant the horse cars hitherto run on the Berlin tramways. The proposal of introducing cable cars has been rejected for the danger which such traction presents, both in technical matters and in hygiene.—L'Energie Electrique.

The spontaneous ignition of coal was known in antiquity. Theophrastus (320 B. C.) in De Lapidibus says: "At Bina (Thrace) there are found brittle stones which will burn, and have long been used as fuel, but they give an offensive smell. In some mines they find spinus, which will ignite spontaneously if crushed, heaped up and moistened." A writer of the eighteenth century attributes the spontaneous ignition of coal to the sulphur contained therein.—Prometheus.

Two tunnels are to be built under the Danube at Budapest. They are to connect the Parliament building with the Romben Platz, and the Boraros Platz with the Kelenföld respectively. The two tunnels are to be built 15½ meters (about 50 feet) below the normal level of the river and are to be 10 meters (32¾ feet) high. There will be a partition dividing each tunnel into an upper and a lower part. The upper part will be for pedestrians and tram cars, the lower part for ordinary traffic.—Uhland's Wochenschrift.

The system of Smith and Granville for connecting lighthouses with the coast is one of the most practicable. At the coast station two metal plates with cables attached are sunk into the earth. At the lighthouse two similar cables are connected to earth in the same way, but here some delicate instrument, such as a reflecting galvanometer, is included in the circuit. An alternating current is sent at intervals through the cables on the land station, and the secondary current produced in the lighthouse cables deflects the needle, so that messages can be sent according to a prearranged code.—Glaser's Annalen.

An ingenious way of simultaneously making and laying drain pipes is used by R. Dockery, at Los Angeles, Cal. The whole thing is done by a rather primitive machine. This consists of a tube, whose diameter corresponds to the outer diameter of the pipe to be produced, in which is fixed from inside a cylindrical plug, leaving a space for the clay to pass. The clay is supplied by a funnel and pressed out by the plug itself, which toward its internal extremity is threaded. During the operation the machine is sunk into the channel dug for the pipes and moves along in plow fashion.—Monatschrift für Oeffentlichen Baudienst.

The production of iron and steel wire nails in the United States in 1896 amounted to 4,719,860 kegs of 100 pounds each, compared with 5,841,403 kegs in 1895, a decrease of 1,121,543 kegs, or over 19 per cent. In 1894 the production amounted to 5,681,801 kegs and in 1893 to 5,095,945 kegs. The wire nails produced in 1896 were manufactured by seventy-three works, thirty-one more than were in operation in 1895. The production of 1896 represented 210,708 gross tons. The total production of cut nails in 1896 was 1,615,870 kegs of 100 pounds each, against 2,129,894 kegs in 1895, a decrease of 514,024 kegs, or over 24 per cent. There has been a steady decline in the production of cut nails since 1886, in which year the maximum production of 8,160,973 kegs was reached. In 1896 the production of wire nails exceeded the production of cut nails by over 3,103,000 kegs. The production of cut nails in 1896 represented 72,137 gross tons. Eleven States made cut nails in 1896.

A thirty five foot entrance to New York harbor is strongly advocated by the Chamber of Commerce and the transatlantic and even coastwise steamship lines, says Engineering News. The river and harbor act of June 3, 1896, directed the Secretary of War to ascertain the location and cost of obtaining a depth of 35 ft. at low water mark from the "Narrows to the sea," and a report upon this head was submitted in January of 1897 by Colonel G. L. Gillespie, Corps of Engineers, U. S. A., and an abstract of this report was given at that time in this journal. A resurvey has now been ordered and the work is being carried on under Lieutenant-Colonel William Ludlow, Corps of Engineers, U. S. A., the successor of Colonel Gillespie. Lieutenant-Colonel Ludlow says that it is not proposed, as reported in the press, to deepen the Coney Island Channel to 35 ft., though that channel may be deepened to 16 ft. to better accommodate coastwise and excursion steamers. The actual work to be performed cannot be reported upon until the present surveys are completed, and all locations, plans and estimates of cost given in the press accounts are premature and unfounded.

The relative cost of transportation by railway and canal is thus expressed by Mr. Leslie R. Robinson in a paper on "Mechanical Propulsion on Canals," lately presented to the London Institution of Mechanical Engineers:

Items of Cost.	Railway.	Canal.
Maintenance of way	13	0
Maintenance of works	7	2·3
Repairs of rolling stock	19	6·0
Traction	16	8·0
Traffic expenses	30	6·0
General charges	15	15·0
Interest on capital	100	33·3
Totals	200	70·6

He says that the three principal causes why transport of heavy goods by canal costs only about one-third as much as by rail are the following: On a canal there is no cost corresponding to the wear and tear of rails, ties or track appliances, though the cost of maintaining banks and locks must be taken into account. In canals there is a corresponding saving of the repairs on engines and rolling stock resulting from running on a rigid permanent way. The most important cause for economy on canals, however, is the absence of vibration and the smaller magnitude of the works themselves. The table given is taken from the evidence of Mr. Conder before the parliamentary select committee on canals.

ELECTRICAL NOTES.

An enterprising burglar has at last ventured to use the means minutely described in some of our contemporaries for burning holes in a safe, says the Electrical World. A few days ago the bank of Messrs. Rogers & Son, at Chagrin Falls, Ohio, was found open and on the floor in front of the safe were found burglars' tools, a pile of sand, carbons and wires leading to the tracks and trolley wire of the street railway, near the building. It is said that big holes had been melted in the combination lock and the molten metal caught in the trough of sand on the floor below. The current had been shut off from the railway line during the night, and it is supposed that this compelled the burglars to desist.

Some Syracuse lads indulged in some "fun" with live electric wires recently. A wire which had been employed as a guy to support an electric light pole had come down and crossed a live wire in falling. The boys attached it to a piece of barbed wire from a neighbor's fence, and laid the latter across the cycle path, from which wheelmen would attempt to remove it in passing and receive a shock. Another trick was to throw it over a trolley wire, making a short circuit and stopping the cars. One boy, barefooted, playing about the spot, grasped the wire and ran his hand swiftly across a point where the insulation had worn off. He was standing with bare feet on the tracks of a disused trolley line at the time. The boy died in about eight minutes. He had received a shock from about 2,500 volts.

The Street Railway Review gives the following information as to the operating expenses of the Calumet Electric Railway, Chicago. The company operates 75 miles of track, all of it double except one mile. The number of cars in use varies from 37 in winter to 200 in summer. There are practically no grades on the line. The distance from the power house to the farthest terminal is 5½ miles. The coal used costs from $1.15 to $1.50 per ton. The road began operating in 1891, and has constantly extended its lines, having 10 miles in 1892, 23 miles in 1893, 53 miles in 1895, and 70 miles in 1896. John MacFayden, general superintendent of the Chester Traction Company, Chester, Pa., says that on that road the operating expenses for the year 1896 averaged $0·0759 per car mile. The company operates 28 miles of track, only two of which are double track; at the extreme end of one division, which is 8 miles from the power house, is a 6 per cent. grade, 1,500 feet long. There are several other grades of from 8 to 10 per cent. The average number of cars operated is 28 per day.

Electricity is finding uses in oil mining in Pennsylvania and promises to develop a large field of application in this direction. An oil company is erecting on one of its farms in Pennsylvania an electrical power plant to supply power for pumping all of its wells in that vicinity and also for drilling new wells. At present all this work is done by a small steam engine at each well, involving long steam lines, great waste of fuel and large expense for attendance. It is believed that a great saving will be effected by having a single power house with electrical transmission to a motor at each well. This plan has been adopted to a limited extent by other companies for pumping oil, but probably the only well hitherto drilled by electric power is the one put down by the Westinghouse Electric and Manufacturing Company near its factory at East Pittsburg, Pa. As the production of oil is a very large and important industry in this section of Pennsylvania, it is quite probable, according to the Electrician, that if the plan above referred to proves to be successful, it will pave the way for a very extensive use of electric power in the oil regions.

The Illustrated American has a description of a large electromagnet with pointed poles (both are pointed) designed for extracting iron filings or splinters that have lodged in the eye. Our contemporary gets quite graphic in describing the operation. "The instrument has a drawing force of 16 lb. As the eye of the patient is pressed toward its point the subtile magnetic power begins to draw upon the splinter. The metal, struggling for release, bulges the eye from the socket. If not too deeply embedded, the splinter will yield to the force, and, leaving the eye, become attached to the point of the magnet. But, as only too often occurs, the metal may strike with such force as to perforate the coating and drop down into the cavity of the eyeball. Especially is this the case when it passes through the iris or the pupil. One instance was mentioned by the attendants of the hospital of a splinter which passed entirely through the eye and lodged in the coating on the other side of the ball. Applied to the eye the big magnet will reveal with accuracy to the skilled sight of the physician the position of the troublesome particle. Knowing this, he can remove it by an operation. Only in the most desperate cases need loss of sight follow."

While an armature has been defined as a bundle of wires cutting magnetic lines, with suitable connections for carrying off the induced current, it is this "bundle of wires" which is the vital part of our electric systems to-day, and has given more trouble and study than all the rest of the system combined. The working capacity of armatures, according to Mr. G. Moffat, in the New York Electrical Engineer, may be said to be limited by two things, sparking at the brushes and the heating of the armature itself. Of these, the heating of the armature has been found the more troublesome of the two on account of the difficulty in overcoming it. To stop sparking at brushes, unless a structural defect, is much more easily accomplished. Besides the element of risk accompanying undue heating, there is a large waste of power, and power means money. In some machines tested, the author has found it necessary to reduce the load almost 50 per cent. before reasonable heating loss was met with. The maker's guarantee that the machine's capacity is 100 per cent. above what is found safe will not bring back the power thus wasted. The heating arising from the friction of brushes, if excessive, may be remedied by better brushes, springs no stronger than necessary to make perfect contact, a true commutator, and, if necessary, a little light-bodied oil applied occasionally which will quicken the polish. The main requisites for cool running would then seem to be: machines run at their true capacity, properly insulated, laminated cores and thorough ventilation.

MISCELLANEOUS NOTES.

According to the lately published statistics of 1895, the number of ships sailing into non-European ports (inclusive of the territories under German protection) has decreased by five; the tonnage, however, has risen by 84,439.—Uhland's Wochenschrift.

A novel system of allowing reduced fares has been instituted in Germany. According to new regulations, holders of ten third-class or eight second-class tickets, i. e., of a whole coupé, are entitled to a free return journey, ten days being the term allowed.—Uhland's Wochenschrift.

At the end of the year 1894 Japan had only twelve steamers of more than 3,000 tons and twenty-nine of more than 2,000. Now there are ten steamers of more than 5,000 tons, two of over 4,000, thirteen of 3,000 and over, fourteen of more than 2,000 and sixty over 1,000 tons. And building is constantly going on, so that there is a demand for increased harbor accommodation. Japan is threatening to become the greatest power on the Pacific.—Uhland's Wochenschrift.

Gas pipes have been made of paper in England. They are said to answer their purpose very well, particularly for underground conduits. They are made of any length required, and passed through liquid asphalt, to render them gas and water tight. It is said that these pipes resist the dampness of the ground, high pressure, and other inconveniences, better than the usual metal pipes. It is, however, doubtful whether good iron pipes coated inside and out with asphaltum are not superior to the cellulose article.—Prometheus.

A new material for paving streets is found in straw. A Polish engineer has designed a method and machinery by which straw is bound with wire, immersed in various hot liquids, and finally in pitch. The straw is then cut into cubes, much like those used for wooden pavement, and is ready for use. These blocks are said to be considerably cheaper than wood, and quite as durable. The straw used must be from unthrashed corn, otherwise it is broken and unfit for the process. The inventor has devised a machine which cuts off the ears from the straw.—Monatschrift für Oeffentlichen Baudienst.

Dr. Joseph Wittlin has made researches as to the value of the various modes of freeing roads from dust. He found that the action of the sun's rays was deadly to bacteria, but that the sprinkling of streets counteracted their effect. So the method of conveying the dust dry to the gutters by means of brushes and then carrying it to the drains by a stream of water is more commendable than the usual sprinkling. But better still is the course taken in England and some parts of America, where the dust is swept together and destroyed by combustion.—Monatschrift für Oeffentlichen Baudienst.

A simple process for bronzing steel, iron and copper is described in Revue de l'Electricité. The article to be bronzed is coated with vaseline, and then heated to redness, and left to itself till the desired color is attained. A second application of vaseline may be necessary if the first supply is burnt away before this point is reached. The article is then allowed to cool and cleaned of the carbonaceous matter clinging to it by rubbing with vaseline. The tint, which resembles that of gunmetal, is probably due to superficial oxidation. The bronze is very permanent, and particularly suitable for steel.

In connection with the recent state procession of the Queen to St. Paul's Cathedral some interesting particulars have been published by the Buildings Committee of the London County Council with respect to the erection of stands. It appears that in all 1226 applications for licenses to erect temporary stagings to view the procession were received. Of these 1,104 were granted, but in forty-eight cases the licenses were not taken up—ninety were refused, eight were withdrawn, and twenty-four were made too late for them to be dealt with. Two hundred and two structures in various parts of London, consisting chiefly of temporary stands and balconies, were condemned.

The Revue Scientifique draws our attention to the longevity of astronomers. We cannot reproduce their whole list of instances, but it may be interesting to our readers if we mention a few. First in the list comes Fontenelle, who lived just 100 years (1657-1757). Then Caroline Herschel, sister to the great Herschel, who reached her 98th year. Cassini died at 97, Sir Edward Sabine at 94, Moiran at 93, Giovanni Santini and Sharpe at 91. Yates, Airy, Von Humboldt, Robinson and Long each lived to the age of 90. The list of those who lived 80 years is so long that we can only give quite a small fraction of the names. Among them figure Halley, Newton, Herschel, Kant and Roger Bacon.

Writing in the scientific department of the Debats, M. Henri de Parville announces that two investigators, MM. Thomassi and Asselot, have succeeded in obtaining a non-inflammable celluloid. M. Thomassi's invention remains his secret, but M. Asselot has given his discovery to the world without delay. He dissolves ordinary celluloid in acetone in the proportion of 25 grammes of the former to 250 grammes of the latter. Then he dissolves, separately, 50 grammes of magnesium chloride in 150 of alcohol, and forms a paste of the two solutions. When the volatile solvents have evaporated there remains, according to M. Asselot, a celluloid which is absolutely uninflammable. He has, it may be trusted, made no mistake, for there can be no doubt that ordinary celluloid, which is mainly guncotton and camphor, is as dangerous as it is useful.

The importation of petroleum into Trieste in tank steamers has given rise to an Austrian government inquiry as to the vapor of petroleum hanging about the tanks and the dangers arising from the explosive mixtures to which it gives rise, says the American Manufacturer. The result is that a method has been adopted by which the air from various parts of the tank is extracted and subjected to a threefold test—with a eudiometer to see whether there is any diminution of volume on explosion, with a Davy lamp to see whether the flame is altered by the suspected air, and with an open flame to see if it is inflammable, and if so, what kind of flame is produced; and it is only when these three tests are satisfactory that a light can be allowed near the tank. Otherwise, ventilation must be vigorously carried out until there is no explosive mixture in any part of the tank.

SELECTED FORMULÆ.

Puncture Cement.—A recently patented preparation for the automatic repairing of punctures in bicycle tires consists of glycerine holding gelatinous silica or aluminum hydrate in suspension. Three volumes of glycerine are mixed with one volume of liquid water glass, and an acid is stirred in. The resulting jelly is diluted with three additional volumes of glycerine, and from four to six ounces of this fluid are placed in each tire. In case of puncture, the internal pressure of the air forces the fluid into the hole, which it closes. Further details are lacking.—American Druggist.

Hair Dye.—There is no hair dye which produces a durable coloration; the color becomes gradually weaker in the course of time, and the new growth of hair always requires after coloration. Here are some typical formulas in which a mordant is employed:

(1.) Nitrate of silver	½	ounce.
Distilled water	3	"

Mordant:

Sulphuret of potassium	½	"
Distilled water	3	"

(2.)

(a.) Nitrate of silver (crystal)	1½	"
Distilled water	12	"
Ammonia water, sufficient to make a clear solution.		

Dissolve the nitrate of silver in the water and add the ammonia water until the precipitate is redissolved.

(b.) Pyrogallic acid	2	drachms.
Gallic acid	2	"
Cologne water	2	ounces.
Distilled water	4	"

(3.) Nitrate of silver	30	grains.
Sulphate of copper	3	"
Ammonia, q. s.		

Dissolve the salts in ½ ounce of water and add ammonia until the precipitate which is formed is redissolved. Then make up to 1 ounce with water. Apply to the hair with a brush. This solution slowly gives a brown shade. For darker shades, apply a second solution, composed of—

Yellow sulphide ammonium	2	drachms.
Solution of ammonia	1	"
Distilled water	1	ounce.

Black Hair Dye Without Silver.—

Pyrogallic acid	3·5	grms.
Citric acid	0·3	"
Boro-glycerin	11	"
Water	100	c. c.

If the dye does not impart the desired intensity of color, the amount of pyrogallic acid may be increased. The wash is applied evenings, following in the morning by a weak ammoniacal wash.

One Bottle Preparation.—

Nitrate of copper	300	grains.
Nitrate of silver	7	ounces.
Distilled water	60	"
Water of ammonia, a sufficiency.		

Dissolve the salts in the water and add the water of ammonia carefully until the precipitate is all redissolved. This solution, properly applied, is said to produce a very black color; a lighter shade is secured by diluting the solution. Copper sulphate may be used instead of the nitrate.—Pharmaceutical Era.

The firm of Golson & Joure have found a mixture suitable for match heads which, although containing no white or yellow phosphorus, may be ignited by friction against any substance. The proportions are:

Powdered glass	80	parts.
Amorphous phosphorus	10	"
Sulphur	10	"

These are mixed, then is added a solution of 850 parts of potassium chlorate in 300 parts of water and 70 of glue. Lastly, there is added to the paste finely powdered potassium ferrocyanide, 50 parts.—Wiener Gewerbe Zeitung.

Photographic Hints and Formulas.—

From Liesegang's Photographischer Almanach.—(Amer. Photo. Jl.)

Metol-Hydro Developer.—For transparency and lantern plates:

(a.) Water	16	ounces.
Metol	30	grains.
Hydrochinon	30	"
Sodium sulphite (crystals)	240	"
(b.) Water	10	ounces.
Potassium carbonate	120	grains.
(c.) Potassium bromide	1	ounce.
Water	10	"

To develop: (a) 1 oz.; (b.) 1 oz.; (c.) 10 to 20 drops. Can be used repeatedly. Temperature should be between 70° and 75° F. Too cold a developer will not give density, while a warm developer tends to give fog.

A Blue Process.—M. Makahara, at the convention of the Japanese photographers, held in Tokio, exhibited some blue prints of rare beauty. The process by which they were obtained was given as follows: A strongly sized paper is necessary. Dissolve 15 grammes of gum arabic in 110 c. c. of hot water; while hot add—

Tartaric acid	2	grms.
Chloride of sodium	9	"
Sulphate of iron	10	"
Perchloride of iron	15	"

The mixture is applied with a sponge to the paper, the sponge then squeezed out, and the excess of liquid removed—in fact, as much as possible is removed. Printing is a little longer than for albumen paper; the yellow of the sensitive paper turns white in printing. The prints are developed rapidly with gallic acid, then washed and sponged.

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THE CAPTIVE BALLOON IN THE NAVY.

At the recent naval maneuvers at Kiel, Germany, the aeronautic division of the German army went through a two weeks' drill, in which the kite balloon described in our paper some little time ago was used for reconnoitering, being made captive on board a torpedo boat.

We may just shortly remind our readers of the construction of the balloon. By means of an attachment on one end, the body, which is elongated, is kept at an angle to the horizontal. The wind, therefore, catches the slanting lower surface as it strikes a kite. The balloon is provided with an air chamber on this surface which prevents it from giving way to the stress and curving. Lastly, there is the usual kite tail, which is raised aloft by an additional circular balloon. The car is independent of the cable which holds the balloon fast. By all these devices great steadiness is secured, and consequently very exact observations can be made.

To be able to transport the balloon quickly from one place to another, the aeronautic division attached it to a torpedo boat, which, owing to its great speed, answered the purpose admirably. But not only was the balloon conveyed from one place to another by this means. The machinery by which the cable was paid out was even transferred from one boat to another without much difficulty.

Experiments were conducted to compare the range of vision from the car with that obtained on lighthouses. The balloon was sent up off Bülk (near Kiel), where a lighthouse rises 97½ feet above the ground. From this tower one can see fifteen miles around, while from the balloon a strong telescope revealed the whole of the Danish seas, even beyond Copenhagen, while in the east Rügen could be distinguished, and in the west the North Sea was visible. The officers of the army and navy practiced recognizing the different ships which were clearly seen in the Great Belt. It is to be expected that this enlarging of the field of vision will be of great importance in naval warfare, as an early recognition of the enemy is always essential.

Our cut is taken from Illustrirte Zeitung.

TORPEDO BOAT TOWING A BALLOON.

POSSIBLE STEAMSHIP SERVICE BETWEEN NEW YORK AND TANGIER.

Consul Burke sends the following from Tangier, June 21, 1897: In view of the opportunity for developing considerable trade between New York and Morocco if steamers touched at this port, I wrote during the past winter to two New York agencies of steamship lines to the Mediterranean to ascertain if it would not be possible and profitable for the companies to include Tangier in their itinerary. The agents of one of the lines informed me it would not be to their advantage, especially as the larger number of passengers by their line did not care to touch at Tangier. The agents of the other line wrote me they would refer my letter to Messrs. Gastaldi & Company, the general agents at Genoa. I also wrote other parties in the United States, asking them to be good enough to interest themselves in the matter, as I felt sure that if steamers touched regularly at this port both from and to New York it would result in our gaining a strong commercial foothold in this country. Whether my efforts in this direction accomplished anything I do not know. I am rejoiced, however, to be able to report that the steamer Sarnia, of the Atlantic line to the Mediterranean, of which Gastaldi & Company are general agents, is advertised to touch at this port on July 2, en route to New York. I understand this is an experiment only; but there is no doubt in my mind that if we have even a monthly service for a few months it will be found necessary, on account of the increase of trade, to establish a bimonthly service for this port. All interested in getting a share of this market for our manufactured products should give aid and encouragement to the proposed venture, in order to render it a success. I have written Messrs. Gastaldi & Company, of Genoa, assuring them that whatever can be done by me shall be done to aid the undertaking. Now, whatever is shipped to the United States goes by way of England, Germany and France. Whatever is brought from the United States must come through the same countries and must of necessity occupy a much longer time in transit. Probably the freight charges are higher when goods are brought in this roundabout way. If the company decides to have a monthly service for this port, our manufacturers and merchants should put commercial travelers in this field at once with samples of their products. A sample house should be opened, with a man at the head who is active, enterprising and shrewd. He should be a man who knows the country and the people, not only of Tangier, but all the coast towns. The whole of Morocco would be his field, and our people would reap benefit. I sincerely hope that the experiment by the Atlantic Line Company in touching at this port will prove successful for them and beneficial in opening a new channel of trade for us, though it may not be very extensive.

The construction of the line Crampass-Sassnitz on Rugen, Germany, which was completed on May 1, offered several difficulties. In some two miles the trains have to ascend a grade of 97 feet. To make the ascent even it was found necessary to cut into the Crampass plain from Crampass to the sea shore. But a greater difficulty yet had to be overcome in laying the track along the shore, where the whole line had to be protected by a sea wall, the building of which involved considerable expense.—Uhland's Wochenschrift.

A NEW SYSTEM OF THROWING HIGH EXPLOSIVES.*

By Hudson Maxim.

For a generation there has been a race for supremacy between guns and armor, between penetration and resistance, between offense and defense. This race has resulted in the development of cannon of comparatively small caliber, but with great thickness of wall and tremendous weight. In order to withstand the enormous pressures necessary to impart requisite velocities to long and heavy armor-piercing projectiles. Powder space within the armor-piercing shell has been sacrificed to weight and strength of metal, reliance being mainly placed upon the smashing effect of a huge bolt of steel. Opposed to this we find the modern battleship, clothed in a wall of steel so ponderous as to reduce mobility to a minimum.

Now, with the advent of a system of throwing high explosives, in sufficiently large masses to render armor absolutely useless, we shall find navies discarding their armor, and everything will be made subservient to speed and mobility. This will work a complete revolution in the construction of ordnance and ships of war. Heavy ordnance, instead of being made, as at present, of small caliber, with thick and heavy walls, will be made of much greater caliber, and with comparatively thin walls. The projectile which will then be employed will be a thin shell, simply thick enough to support the mass of contained explosive in its flight from the gun; and the explosive will be sufficient in quantity to work infinitely more destruction upon any target than such projectiles as are at the present day thrown from heavy guns.

One of the requisites of primary importance to a system of successfully throwing high explosives in large masses rests upon the propelling charge—upon a suitable gunpowder—one which will give a sufficiently low initial pressure, and maintain that pressure behind the projectile in its flight throughout the entire length of the gun, and a powder which will, with absolute certainty, burn alike at all times under like conditions, in order that predetermined pressure and velocities may be depended upon.

I first began the investigation of the subject of high explosives and smokeless powders in England in 1889. Since that time I have built two powder mills in America, one for the manufacture of high explosives, the other for smokeless cannon powders. In connection with my other work on these lines, I conducted a large number of experiments for the Pneumatic Torpedo and Construction Company, of New York, formerly known as the Zalinski Pneumatic Dynamite Gun Company, looking to the production of a smokeless torpedo powder; that is, a powder for the purpose of throwing high explosives, or aerial torpedoes, from ordnance.

The distinguished chemist Dr. Robert C. Schüpphaus has been associated with me in this work. He is also an inventor, and his extensive chemical knowledge and experience in connection with nitro compounds particularly qualified him for this work.

Owing to the shortness of range of the pneumatic guns, and to the expense, cumbersomeness and vulnerability of the plant necessary to operate them, it was determined, if possible, to substitute gunpowder for compressed air.

How well we have succeeded in the Maxim-Schüpphaus smokeless powder to accomplish the desired results, and the special advantages that this powder has for the purpose, is one of the things which I shall here try to explain.

One of the great advantages of high explosives as an agency of destruction is the impossibility of opposing to them any efficient means of protection, when applied in large quantities. By the subdivision of the hull of the modern battleship into a honeycomb of water-tight compartments, and by surrounding it with torpedo netting, some protection is secured against attack from even the largest of present forms of torpedoes, such as the Whitehead, but the largest and latest type of these will carry but 200 lb. of guncotton. It remains only to be able to attack with a sufficiently large quantity of explosive in order to render absolutely useless as a means of protection all precautions in the form of network and water-tight compartments. Five hundred pounds of guncotton exploded against the torpedo netting surrounding a modern battleship would insure her destruction, to say nothing of what would result from the explosion of still larger quantities.

The nearest approach to the system proposed by me for throwing high explosives that has yet been developed is the system of throwing them by means of compressed air. But the shortness of range of pneumatic guns, the difficulty and expense of protecting them, and the enormous plant of engines, boilers and air compressors necessary, are strong objections to their use for coast defense; while their cumbersomeness and vulnerability, together with the above objections, render their employment on shipboard entirely out of the question.

With the 15 inch pneumatic guns that have been erected in the United States, at Sandy Hook and San Francisco, 500 lb of high explosive may be thrown a distance of about one mile and a quarter; 200 lb. about two and a half miles, this is the maximum range. Hence a battleship could lie just beyond the range of these guns and destroy the entire outfit, without in turn being in the least exposed to the fire of the pneumatic tubes. It is obvious, therefore, that a practical system of throwing aerial torpedoes must have a range substantially equal to that of high-power guns opposed to it, and the quantity of high explosive thrown must be sufficient to effect upon the target greater destruction than can be effected by ordinary shells thrown from heavy ordnance.

Fig. 1 is a sectional view of my improved aerial torpedo and fuse, carrying half a ton of compressed wet guncotton. Fig. 2 is a 12 inch torpedo of the same pattern, carrying 250 lb. of guncotton. The object of this invention is mainly to provide an aerial torpedo projectile which shall carry a maximum of high explosive with a minimum weight of metal, and at the same time be of such constitution, strength, and integrity as to enable it to withstand the shock of acceleration and the pressure of the propelling gunpowder charge, without danger of disruption or distortion of the torpedo, or the premature explosion of it.

* Digest of a paper read before the United Service Institution, London.

The torpedo projectile is preferably made in two sections, a forward and a rearward portion, and joined together in the following manner: The forward portion is made somewhat thicker than the rearward, and the rear end of the forward section is reduced in thickness sufficiently to permit of the two portions being telescoped together, as shown in the drawing. The parts are made to fit closely, and are forced together with considerable pressure, in order to make a very tight joint.

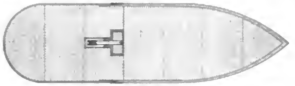


Fig. 1.—MAXIM AERIAL TORPEDO CARRYING ONE TON OF GUNCOTTON.

Fig. 2.—MAXIM AERIAL TORPEDO CARRYING 250 POUNDS OF GUNCOTTON.

To effect the simultaneous rotation of both portions of the torpedo, they are provided with interlocking projections or tongues, and a strong copper driving ring is shrunk or affixed on the projectile at the point of union of the two sections, and overlapping both portions, thus forming an efficient hermetical seal, while at the same time joining the two portions firmly together.

A very suitable high explosive for this torpedo is wet guncotton, previously highly compressed in a series of suitable moulds of proper size and shape, to adapt the cakes or blocks to closely fit a corresponding space in the torpedo. After the torpedo has been filled in the manner described, to such fullness as to prevent the rearward section being forced quite home upon the forward portion, or abutting against the thicker body of the forward section, the two ends are placed together, and the torpedo is subjected to considerable pressure in a longitudinal direction, sufficient to secure the maximum density of the contained high explosive charge. The gas check and driving ring is then affixed in the manner already explained.

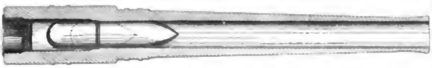


Fig. 3.—SECTION OF MAXIM 46 TON TORPEDO GUN, SHOWING TORPEDOES CARRYING HALF A TON AND A TON OF GUNCOTTON.

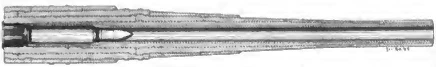


Fig 4.—SECTION OF WOOLWICH 67 TON GUN WITH ARMOR PIERCING SHELL.

When compressed guncotton is used for filling the torpedo in the manner described, its density and unyielding nature cause it to serve as a support to the walls of the projectile and prevent its disruption or distortion under the great pressure of gases of the gunpowder charge, and the sudden shock of acceleration, thus permitting the use of thinner walls than when filled with a more yielding material.

The walls of the forward section of the torpedo are made thicker than those of the rearward portion, in order to give greater weight to the forward end of the torpedo to secure a truer flight, and also such strength as to enable it to penetrate deck armor or earthworks before exploding.

Figs. 3 and 4 illustrate the position of the guncotton torpedo in the gun, as well as its size, compared with other forms of projectiles now in use, thrown from guns of half the caliber, but of greater weight, and of the same exterior dimensions from forward of the trunnions back to the rear of the gun.

The whole of the rearward section of the torpedo projects backward from the driving ring and ring seat into the powder chamber, so that the entire rear portion of the torpedo is surrounded by the gases of the propelling powder charge, which exert their pressure upon it simultaneously on all sides, causing the rearward section to move slightly forward and press hard upon the forward portion, thereby communicating the pressure of the propelling charge to the high explosive contained in the torpedo, which, from its great rigidity and density, is practically incompressible, and prevents the thin shell of the rearward section from collapsing.

It is obvious that inasmuch as the torpedo extends backward beyond the driving ring into the powder chamber, it will be accelerated just so much more by the propelling gases, which give an increased velocity equivalent to a like lengthening of the gun.

The fuse employed is one adapted to explode when the torpedo shall have penetrated to a desired depth in water, earthworks, or the deck of a ship, its action being dependent upon a certain amount of retardation of the torpedo.

Fig. 4 shows, in section, a 67 ton built-up gun of 13½ inch caliber. It shows how it is constructed from sixteen rings or layers of steel, shrunk upon one another. This form of construction and the enormous thickness of wall are necessary to withstand the enormous pressures employed, of 35,000 to 40,000 lb. to the square inch. The gun shown in Fig. 3 is one designed by me for throwing aerial torpedoes. It may be made either from a single casting or a single forged steel tube. You will observe that the diameter of the gun from the rear portion forward one-half its length is the same as that of the 67 ton gun shown in the center, but the caliber of the torpedo gun is 27 inches, twice as great as that of the 67 ton gun; the caliber being doubled at the expense of thickness of the wall, for the two guns, as shown, are of the same exterior dimensions for about one-half their length.

We are enabled to double the caliber, and so materially reduce the thickness of the wall and lighten the

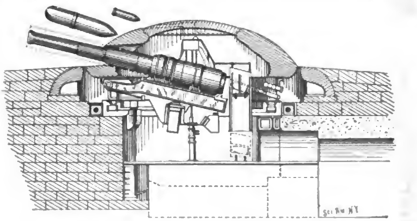


Fig. 5.—ELSWICK TURRET WITH GRUSON CUPOLA MOUNTING.

gun, by simply using a pressure of 10,000 lb. instead of 35,000 to 40,000 lb. This innovation is especially desirable in a torpedo gun, because we do not desire to shoot with an object to penetrate armor, and do not care for a flat trajectory; we desire only an equal effective range to other types of guns, and this rarely.

In the torpedo gun we have a caliber twice as great as in other guns, and consequently have four times the area at the base of one projectile. Therefore, with a projectile of equal weight, we can get a higher velocity with 10,000 lb. to the square inch than can be attained with the high pressure guns employing 35,000 lb. These calculations are based upon the assumption that we have equal length of travel of projectile in the gun, and a pressure in both cases equally well maintained behind the projectile; but we have in favor of this torpedo gun and the torpedo projectile the great advantage that, for a gun of equal length, we get a materially increased length of travel of projectile, and by the employment of a propelling gunpowder charge explained further on, which maintains the pressure practically the same to the muzzle, we are enabled to get a much higher velocity for equal weight of projectile than by the other system.

The projectile used in the British 12 inch wire gun is

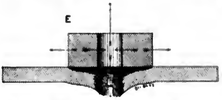


Fig. 6.—AN EXPERIMENT ON THE PHILOSOPHY OF EXPLOSIONS.

three calibers long, and weighs 850 lb. With a propelling charge of 167 lb. 8 oz. cordite, and with a pressure of from 35,000 to 40,000 lb. to the square inch, the projectile is thrown from the gun at a velocity of about 2,350 foot seconds. In the torpedo gun at the top of the drawing is shown a torpedo projectile, carrying 1,420 lb. of picric acid. The total weight of this torpedo will be about 2,700 lb. With a powder charge of 167 lb. Maxim Schüpphaus torpedo powder, and a pressure of 10,000 lb. to the square inch, and with a travel of projectile in the gun of more than seven and a half feet greater than in the wire gun, the torpedo projectile leaves the gun with an enormously greater energy than that of the projectile thrown from the wire gun; but as the projectile thrown from the wire gun has much greater sectional density than the torpedo projectile, it loses less velocity in overcoming atmospheric resistance. However, this is somewhat counterbalanced with the torpedo gun by a higher angle of fire, so that enormous quantities of high explosive can

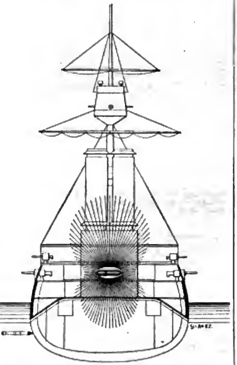


Fig. 7.—EXPLOSION ON BOARD A BATTLESHIP OF THE MAJESTIC CLASS OF A 24 INCH AERIAL TORPEDO.

At lower left is an 18 inch Whitehead torpedo. Black head shows quantity of guncotton carried.

be thrown to a great distance. The torpedo projectile, carrying 1,420 lb. of picric acid, will leave the gun with a velocity of about 2,000 foot seconds, with a range of nearly nine miles. The torpedo enlarged to the dotted lines in front will carry one ton of picric acid, will have a velocity of about 1,500 foot seconds, and a range of about five miles.

The total energy of projection imparted to each torpedo projectile will be practically the same. In the smaller, mass is sacrificed for velocity; in the larger, velocity for mass, so that the total energy of recoil of the gun will be practically equal for each projectile; but as there is somewhat more energy imparted to the aerial torpedo than to the projectile thrown from the wire gun, and as the guns are of equal weight, there will be slightly more recoil to the torpedo gun, but not enough to be a source of any practical difficulty.

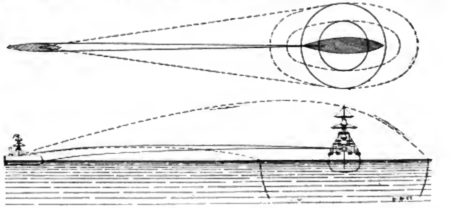
To assist our imagination a little in its realization of the superior destructive energy of these torpedo projectiles above the common armor piercing shell thrown from the high power guns of the present day, I will call your attention to Fig. 5, which is a section through an Elswick turret with Gruson cupola armor.

We can easily appreciate at a glance the superior efficiency of the torpedo projectile as a means of destroying these steel-inclosed bulwarks. The terrible concussion of the explosion upon or against the armored protection, even if it did not totally demolish the steel wall, would certainly throw the gun out of action and

The maximum effective range of the Whitehead torpedo, carrying 200 lb. of guncotton, is less than one mile, and less than one fifth the range of the aerial torpedo carrying eleven times the quantity of high explosive. The efficiency of the aerial torpedo is, therefore, more than fifty times greater than that of the Whitehead.

After conducting a very large number of experiments, Gen. Abbot, of the United States army, estimated a pressure of 6,500 lb. to the square inch, great enough to be fatal to a modern battleship; while Lieut.-Col. John T. Bucknill, in his book entitled "Submarine Mines and Torpedoes," concludes that a pressure of 12,000 lb. to the square inch is necessary to inflict a fatal injury upon the hull of the strongest battleships now made.

Five hundred pounds of guncotton will be fatal, therefore, at a distance of about 38 ft.; maximite and picric acid, about 47 ft.; nitro gelatin, about 54 ft.; one-



Figs. 8 and 9.—COMPARISON OF DESTRUCTIVENESS OF A $500,000 CRUISER WITH THAT OF A $5,000,000 BATTLESHIP.

kill all the gunners, to say nothing of the wreck it would occasion elsewhere, especially on board a battleship. It is hard to predetermine exactly the amount of damage which would be wrought by the explosion of half a ton of guncotton, to say nothing of a ton, upon one of the turrets of a battleship, but the destruction, even though not fatal to the vessel, would be very extensive.

In Fig. 6 we have a very curious illustration, indeed, of explosive energy. A cylindrical body of compressed guncotton, with a hole through the center, was placed on a piece of thin armor plate and detonated; the waves of explosion moving in all directions, as indicated by the arrows, and meeting at the center of the hole, are diverted in the direction of the vertical arrows, with greatly increased density and accelerated velocity, thus blowing a hole through the steel plate directly beneath where the hole was in the guncotton, the plate being simply indented beneath the solid portions of the body of the guncotton.

Fig. 7 illustrates the direction of the action of explosion of an aerial torpedo in its transit across the deck of a battleship. The explosive, being tamped by its own weight, and by the resistance of the surrounding air, will react upon the ship's deck with a disruptive effect similar to that of a torpedo exploded under water adjacent to the unprotected side or bottom of the vessel.

We will now extend our comparisons to other systems of torpedo warfare. Of the many types of torpedoes, the most successful have been the Howell and the Whitehead. The Whitehead, standing in the lead, may, therefore, be taken as the best representative of what has been accomplished in locomotive torpedoes.

half ton of guncotton, about 85 ft.; one ton of guncotton, 108 ft.; while a ton of nitro gelatin would be fatal at 230 ft. As guncotton is the standard service high explosive in this country, I have given special prominence in the table to the destructive range of this substance.

Figs. 8, 9 are intended to illustrate the destructive efficiency of the blast of high explosives as compared with the smashing effect of the blow given by the bolts of steel or armor-piercing projectiles thrown from high power guns.

Fig. 10 gives an enlarged plan view of the deck of the battleship shown in Fig. 9, with numbers showing the areas of the zones of destruction within the circles drawn about the battleship.

The modern first-class battleship costs about $5,000,000. It carries an armament of four 12 in. wire guns, twelve 6 in., and eighteen 3 and 6 pounders, and five torpedo dischargers. Not more than one-half of the guns can be trained upon a single target at one time. Now, at an equivalent expenditure, we can construct and oppose to this ten torpedo cruisers, costing $500,000 each. This sum will construct a very respectable sort of craft, and one which will carry one 24 in. torpedo gun weighing 46 tons, and two torpedo mortars, weighing 20 tons each. The cruiser would fight head on, and the exposed portion could be protected by deflected armor, sufficiently thick to turn aside all shots thrown from a battleship except those from 12 in. wire guns. The torpedo gun would be capable of throwing half a ton of guncotton nearly nine miles, and one ton about five miles. Each mortar will be capable of throwing 500 lb. four miles, half a ton about three miles, and one ton nearly two miles.

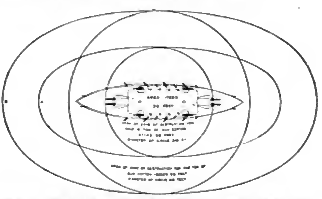


Fig. 10.—DECK VIEW OF BATTLESHIP MAJESTIC, SHOWING DESTRUCTIVE AREA OF AERIAL TORPEDO EXPLOSION.

The Whitehead is a perfect marvel of ingenuity, and the accuracy with which it will travel beneath the surface of the water and strike its target is wonderful. The first torpedoes of this type carried only 18 lb. of dynamite. The quantity of explosive has been constantly increased, and the largest and most powerful to-day carry 200 lb. of guncotton. I will enter into no description of the details or mode of operation of the Whitehead torpedo—a subject so well known—but Fig. 7 will illustrate the comparative sizes of the largest Whitehead torpedo placed alongside one of the 24 inch aerial torpedoes already described, carrying one ton of guncotton.

The tremendous difference in the quantity of explosive carried is very striking, and speaks for the vastly greater efficiency of the aerial torpedo.

The size of the target presented by the cruiser fighting head on would represent an area about equal to her cross section above that portion protected by the water, while the target presented by the battleship to the cruiser would be in proportion to the quantity of high explosive thrown by the cruiser; and to give an idea of what this really means, there is shown on the right a modern battleship, and on the left a torpedo cruiser of the character just mentioned, pictured in the act of firing upon each other. The full lines drawn from the battleship to the cruiser show the trajectory and angle of fire of the battleship, and also within what a limited angle the fire of the battleship must be confined in order to hit the cruiser at all. The dot and dash lines show the angles within which an aerial torpedo carrying a ton of guncotton would be fatal to

the battleship, and the tremendous size of the target presented by the battleship to the torpedo cruiser. At the top of the drawing is a plan view showing the difference in the areas of the decks of the two vessels. Now, the battleship, in order to do any harm whatever to the cruiser, must, of course, make a hit, and to be fatal, that hit must be made in a vital spot, representing an area much more confined even than that represented by the deck of the vessel. As the cruiser would stand and fight with armored head on, the chance of a hit being fatal would be very small; while every torpedo, carrying from half a ton to a ton of guncotton thrown from the cruiser, and striking the area represented by the deck of the battleship, would at least throw the ship out of action, even if it did not sink her. But, in addition to this, we have the tremendous areas within which such quantities of high explosive, striking in the water, would be certainly fatal.

The lines drawn about the area represented by the deck of the battleship show the distances within which different quantities of guncotton would, according to the table, disrupt or crush the hull of the battleship. Half a ton of guncotton, striking anywhere within the space encircled by the line A, would exert upon the hull the required destructive pressure of 12,000 lb.; and one ton within the tremendous area inclosed by the line B. But, as such a blow upon either end of the battleship, although crushing it, would not necessarily be fatal, on account of the transverse bulkheads and watertight compartments, I have drawn about the battleship two circles, representing distances within which half a ton and a ton of guncotton, respectively, falling, would exert upon the hull of the battleship a pressure of 12,000 lb. in such proximity to her vitals as would be certainly fatal.

The cruiser would have a speed of from 20 to 24 knots, and could, therefore, choose her own position with respect to the battleship. Her tactics would not be like the ordinary torpedo boat, to dash into and run a gauntlet of destructive fire from the battleship, to drop a torpedo and away again out of range; but she would stand her ground and fight, always at a distance and in a position of her own choice, with armored head toward the battleship. In such position the target presented by the cruiser would be very small indeed, to say nothing of the difficulty of inflicting a fatal injury upon such a target with ordinary shot and shell.

The fatal area presented by the battleship as a target to half a ton of guncotton thrown from the cruiser is 47,143 sq. ft., and the fatal area presented to a ton of guncotton is 182,925 sq. ft., and it is a very safe estimate that the area exposed by the cruiser fighting head-on would not be more than one two-hundredth as great as the fatal area exposed by the battleship. Now, as every shot from the cruiser striking within the fatal area exposed by the battleship would destroy her, and as it would take a considerable number of hits from the battleship to sink the cruiser, it is very safe to offset the greater number of shots which the battleship could fire within a given time and the horizontal position of the target presented by her by the superior fatality of the shots from the cruiser. This enables us to very easily approximate the comparative efficiency of the two systems, by simply dividing the average fatal area exposed by the battleship by the area of the target presented by the cruiser. Now, as this area is contained in the area exposed by the battleship at least 100 times, one cruiser would be capable of destroying, on an average, 100 battleships. But we can build ten such cruisers for what it would cost to build one battleship, and we must, therefore, multiply this efficiency by ten. This means that we could, for the cost of one battleship, produce a fleet of torpedo cruisers which would be capable of destroying 1,000 first-class battleships.

These are, indeed, astounding figures. They are, nevertheless, based on such foundation in facts as to, at least, warrant our placing them in a category of practical probabilities.

In the choice of a high explosive for aerial torpedoes there are several desiderata, in addition to the mere force of the explosive. In the first place, it should not be so sensitive to shock or percussion as to be in the least endangered by the sudden force of acceleration exerted upon it in the gun. It must be perfectly stable and undergo no change by time and under varying conditions of temperature. It must be perfectly neutral, having no effect upon the metallic surfaces exposed to it. It should have as high a specific gravity as possible, in order to exert the maximum energy per unit volume. There is one more and very important desideratum, not possessed by any other explosive in like degree as by wet guncotton, and that is insensitiveness to detonation, not only from shocks of percussion, but shocks of ordinary forms of explosion. Guncotton can only be detonated by the explosion of a powerful detonative charge in direct contact with it.

Nitro-gelatin is the most powerful of commercial high explosives, but this explosive is too sensitive for employment in aerial torpedoes to be thrown from guns by gunpowder at high velocities.

Maximite is a title which was first applied to a high explosive invented by me and made according to my United States patent No. 544,924. A stiff nitro-gelatin of the character of that just above described, consisting of about seventy to eighty parts nitro-glycerin and twenty to thirty parts of a very soluble variety of gelatin-pyroxylin, soluble in nitro-glycerin below 100° F., is frozen stiff and then cut into sawdust by a gang of saws. About seventy-five to eighty parts of this explosive sawdust is mixed and thoroughly incorporated with about twenty to twenty-five parts of finely pulped tri-nitro cellulose, the whole being saturated with water. The object of the fibrous tri-nitro-cellulose is to absorb and hold water and lessen the sensitiveness of the compound. The compound may be packed into shells to a density of about 1·4, holding about 15 per cent of its weight of water, the excess of the water being poured off.

Projectiles filled with maximite may be thrown from ordnance at service velocities with perfect safety. This compound will detonate under the influence of a strong exploder with all the violence of the original ingredients of which it is composed.

Picric acid is a very powerful high explosive, and when melted and cast it has a specific gravity of 1·7. It is highly insensitive to all ordinary influences and is, therefore, exceedingly well adapted for use in aerial torpedoes.

In view of the highly insensitive character of wet guncotton, and the fact that it is as powerful as No. 1 dynamite, to say nothing of the other high explosives just mentioned, it is hard to see the need of air guns if we have a suitable torpedo powder, by which low pressures can be had and maintained and projectiles with thin walls be thrown with safety.

In making a comparison between the system shown you to-day and that of the best system yet developed for throwing torpedoes by means of compressed air, erected at Sandy Hook and San Francisco, in the United States, it may be noted that the caliber of the largest of these pneumatic guns is only 15 inches, while its length is 50 feet and its weight 70 tons. Its maximum range with 500 pounds of high explosive is about a mile and a quarter. The pressure employed in the gun is only about 1,000 pounds to the square inch—greater pressure than this having been found impracticable.

TESTS OF THE STRONG BALANCED LOCOMOTIVE AT PURDUE UNIVERSITY.

The Strong balanced locomotive, after undergoing successful tests in actual service, was recently sent to the celebrated locomotive testing plant at Purdue University, in order that the results obtained on the road might be corroborated by the more careful methods of the laboratory. This engine, which in its original form attracted more favorable comment from the railroad press than any modern locomotive, has been fully illustrated from time to time in our various publications, and the reader is referred to the SCIENTIFIC AMERICAN and the SUPPLEMENT, respectively for November 14 and 21, 1896, where a detailed description will be found. The following abstract of the report of Prof. W. F. M. Goss, under whose supervision the tests were carried on, is taken from the Railway Age, to which the latter was contributed by Mr. George S. Morison, the vice president of the Balanced Locomotive and Engineering Company.

The locomotive will be recognized as embodying some principles of construction embraced in what was originally known as the Strong locomotive, exploited to a considerable extent over a period of several years beginning with 1887.

Three radical departures from ordinary practice are involved in the construction. These relate respectively to the system of compounding and connecting the valve motion and the construction of the firebox. The last named consists essentially of a pair of tubular shells circumferentially corrugated. The corrugation largely increases the amount of firebox heating surface as well as adding so materially to the strength of the shell that the necessity of staying is obviated. The two corrugated shells which form the firebox proper are brought together at their forward end and united in a single shell, also corrugated, which serves the purpose of a combustion chamber.

The valve motion, which formed a unique feature of the Strong locomotive, has been retained in the present example, but as its working formed no part of the test with which the present report deals, its description is omitted.

The arrangement of the cylinders and connections is not complicated. The two high pressure cylinders are located inside the frames and are connected with cranks upon the shaft. The low pressure cylinders are outside the frames in the position of the cylinders of an ordinary simple locomotive and are connected outside in the ordinary manner. The inside crank of one side is connected at a point diametrically opposite the outside connection upon the same side, and the corresponding cranks upon one side are at right angles with those upon the other side. A full description, with diagrams showing the effect of such construction upon the question of counterbalancing, is contained in Prof. Goss' report, which follows.

A REPORT OF TESTS TO DETERMINE THE CONDITION OF DRIVE WHEEL BALANCE IN "BALANCED COMPOUND LOCOMOTIVE NO. 1." OUTLINE OF TESTS.

In preparation for the tests the engine was mounted upon the locomotive testing plant of Purdue University, which provides: 1, Supporting wheels carried by shafts running in fixed bearings to receive the locomotive drivers and to turn them; 2, brakes mounted upon the shafts of the supporting wheels and having sufficient capacity to absorb continuously the maximum power of the locomotive; and (3) a traction dynamometer to indicate the pulling force exerted by the locomotive wheels. The arrangement of the plant is such that a locomotive mounted upon it may be driven by its own steam at any speed and under any load, the conditions being similar to those of the track.

When the engine had been thus mounted, provision was made for passing lengths of small soft wire under the tread of the drivers while the engine was running at speed, the expectation being that the thickness of the wire as it came from under the wheel would bear some relation to the pressure imposed upon it during its passage. It was thought that if through the action of the counterbalancing, or from any other cause, the pressure of the wheel upon the track should chance to vary as it revolved, the resulting wire would vary in thickness.

That such expectation was reasonable may be inferred from results of similar tests previously conducted in connection with a locomotive which was balanced in a manner now common on all roads. Wires which had been passed under the wheels of this engine not only showed regular variation in thickness, corresponding with definite portions of the wheels' cycle, but when the speed was high, portions of the wire would retain their original section, notwithstanding the fact that they had passed under the tread of the wheel, showing conclusively that the wheel had risen entirely clear of its support during a portion of its revolution.

SUMMARY OF RESULTS.

The results of the tests fully confirm the theory which underlies the design of those portions of the engine affecting the balance of the drive wheels. In the course of the tests wires were repeatedly obtained both from main and rear drivers, while the engine was working at a high speed, which were practically uniform in thickness. A full description of typical wires is given in another portion of this report, and sample wires are submitted. They show that there was little or no variation in the pressure with which the drivers act upon the supporting wheels, and justify the conclusion that the maximum wheel pressure, when the engine is running at speed, is practically no greater than the static pressure due to the weight of the engine; in other words, the so-called "hammer blow," which attends the action of ordinary engines when run at high speed, does not appear in the action of the balanced locomotive.

In discussing the behavior of engines which are balanced in the usual manner, Prof. Lanza, in a paper presented to the American Society of Mechanical Engineers, says:

"There are five different motions which the locomotive (of ordinary type) would receive through the action of the reciprocating parts if free to obey them. They are as follows:

"1. Jerking, or forward and backward motion.

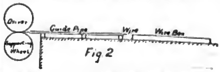
"2. Nosing, an oscillation about a vertical axis through the center of gravity.

"3. Galloping, an oscillation about a horizontal axis at right angles to the track.

"4. Pounding, a vertical up and down motion.

"5. Roll, an oscillation about a horizontal axis."

Without attempting to distinguish between all of these several oscillations, it may be said that experience with testing plants proves that with both eight wheeled and ten-wheeled engines of the ordinary types, running at speed, the jerking is so severe as to make it difficult to hold the engine under test to its position on the plant, while the nosing action results in a side swing of the front bolster through a distance of from a quarter to three-eighths of an inch, depending upon the speed.

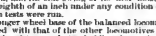


METHOD OF INTRODUCING WIRES.

The balanced locomotive, on the contrary, gives very little jerk, and the side swing of its first bolster is not over an eighth of an inch under any condition of speed at which tests were run.

The longer wheel base of the balanced locomotive, as compared with that of the other locomotives referred to, would assist somewhat in holding the engine steady, while, on the other hand, the bolster from which measurements were made is located well out in front of the body of the engine, a position much farther from the drive wheels than that occupied by the bolsters of the engines referred to, and one which makes apparent a very slight angular movement.

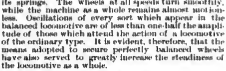
The conclusion is, therefore, that whatever the speed, the wheel pressure of the balanced locomotive will not vary except as the wheels may be acted upon by accidental forces, as for example impact due to inequalities in the track or changes in the position of the center of gravity of the heavier portions of the machine relative to wheels, through the engine rocking or tipping on its springs. The wheels at all speeds turn smoothly, while the machine as a whole remains almost motionless. Oscillations of every sort which appear in the balanced locomotive are of less than one-half the amplitude of those which attend the action of a locomotive of the ordinary type. It is evident, therefore, that the means adopted to secure perfectly balanced wheels have also served to greatly increase the steadiness of the locomotive as a whole.



FORM OF END OF WIRE.

A DISCUSSION OF COMMON PRACTICE IN BALANCING DRIVE WHEELS.

In an eight-wheeled locomotive of the ordinary type there are connected directly and indirectly with the cranks on each side, a coupling rod, main rod, crosshead, piston rod, and piston (Fig. 4).



DISTRIBUTION OF WEIGHTS TO BE BALANCED.

When the engine is in motion, every portion of the coupling rod follows a circular path, and the effect of the centrifugal forces resulting from it, which alone affect the balance of the wheels, is the same as would result if its place were taken by weights symmetrically disposed about the two crank pins, each weight having half the mass of the rod.

The main rod has different motions at every different point throughout its length. The crank pin end follows a circular path, while the crosshead end moves along a straight line; the effect of this motion, so far as it concerns the balance of the wheels, being the same as that which might be produced by an imaginary rod, one portion of which is assumed to follow a circular path only, and the remaining portion a rectilinear path only. That is, a portion of the mass of the rod such as that upon the right of the dotted line, A, Fig. 4, may be assumed to be simply a revolving mass attached to the crank pin, while the remaining portion may be assumed to partake of the motion of the crosshead only, of which, in effect, it becomes a part.

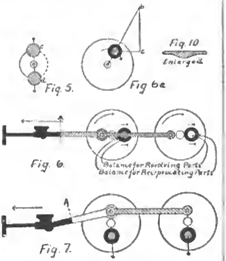
The rotating parts, therefore, which require attention in balancing the drive wheels are the cranks, the crank pins, the coupling rods, and a portion, usually about two-thirds, of the main rod; the reciprocating

parts are a portion, usually a third, of the main rod, the crosshead, the piston rod, and the piston. In Fig. 4 the revolving parts are shaded, while the reciprocating parts are in outline.

A perfect balance of all the revolving parts attached to the pins, and of the cranks and crank pins themselves, may be secured by adding weights to the opposite side of the wheels, the condition for each wheel then being that shown by Fig. 5, in which the masses s and d are assumed to be revolving about the center c, the one representing the masses connecting with the crank pin, and the other the mass of the counterweight. As the centrifugal action of each of these masses is radial, and as the masses are on opposite sides of the center about which they rotate, the system is in perfect balance.

But it is to be noted that all this applies to the revolving parts only. A locomotive in which the counterweights are only equal to the revolving weights (Fig. 4), if used at the head of a train, will act upon the latter by a succession of jerks which will be too severe in their effect to be permitted.

The reason for this will be understood if we consider



ACTION OF EXCESS BALANCE.

the conditions existing in an engine at speed at the instant the cranks are passing the center; that is, when they are in position shown by Fig. 6. At this instant, the radial force exerted upon the crank pin, arising from the motion of the connected parts, is the sum of that due to the rotating parts, plus that due to the reciprocating parts.

To make the engine pass the centers smoothly, therefore, additional weights are put into the wheels, which are shown diagrammatically by the black annular masses in Fig. 6. This portion of the counterweight, which is in excess of that required by the revolving parts, and which is added on account of the reciprocating parts alone, is called the "excess balance."

In the position shown by Fig. 6, the excess balance acts in opposition to the reciprocating parts, and when properly proportioned may hold them in perfect equilibrium; but with a change in the position of the wheel this condition ceases and other conditions appear.

Thus, Fig. 7 shows a change of a quarter of a revolution.

In the new position the action of the excess balance

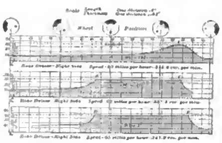


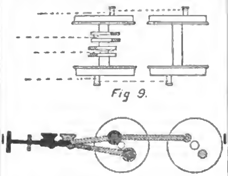
FIG. 8.—DIAGRAMS OF WIRES FROM ORDINARY LOCOMOTIVES.

cannot in any way be opposed by that of the reciprocating parts; and hence, its only effect is to increase the force with which the wheel presses upon the rail.

To make the statement of the whole matter a trifle more technical, but vastly more comprehensive, it may be said that since the counterweights move in circular paths, it is only the horizontal component of the radial force derived from them which can serve to neutralize the effect of the reciprocating parts; the vertical component of all that portion of the force which applies to reciprocating parts, that is, of the excess balance, is unbalanced. This unbalanced vertical component causes the pressure of the driver on the rail to vary with every revolution, its changing value being well illustrated by Fig. 6a, in which a b is the radial force, a c the horizontal component and b c the vertical component, resulting from the rotation of the counterweight about the center o. If the counterweight revolves at a uniform speed, the radial force will be constant, but the value of the components a b and a c will constantly vary, one increasing as the other diminishes.

The Purdue experiments were conducted in a manner similar to those made in connection with the balanced engine already described, and a detailed description of them is presented as an appendix to this report. Fig. 8 gives the actual thickness of some of the wires at different phases of the wheel's motion.

As the result of theoretical research, observation upon the road, and of laboratory investigation, the destructive effects upon track and bridges arising from the presence of the excess balance is now generally recognized; but, notwithstanding this there have been as yet few attempts to abolish the excess balance, which is the root of the evil. The fact still remains that an engine of the ordinary type pulls its train most smoothly and rides the easiest when the excess balance is equal to the full weight of the reciprocating parts. A common rule allows the excess balance to be equal to 70 per cent. of the weight of the reciprocating parts, and requires that it be equally distributed between the coupled wheels. The present rule of the American Master Mechanics' Association requires that one four-hundredth part of the weight of the engine be subtracted from the weight of the reciprocating parts of each side to find the weight of the excess balance, which



CONNECTIONS OF THE BALANCED LOCOMOTIVE.

must be divided equally among the coupled wheels on each side. If applied to most engines now running, this rule would give substantially the same results as the first one stated; but for the very heavy engines now built, it allows a larger proportion of the reciprocating parts to go unbalanced; a practice which is justified because of the ability of the heavier machines to absorb the oscillating forces developed by the motion of the reciprocating parts before they can be transmitted to the train.

There has been no lack of effort on the part of superintendents of motive power to make locomotives of the ordinary type less destructive to track, but it is very doubtful if all that has thus far been done has accomplished more than to prevent a growth of the evil, as engines have been increased in size and speed.

THE PRINCIPLES UNDERLYING THE DESIGN OF THE BALANCED LOCOMOTIVE.

Referring to the mechanism of one side of the balanced locomotive, there is outside of the frame a low pressure cylinder, the reciprocating and revolving parts of which connect with crank pins in the usual manner. These parts are shown in black in Fig. 9. Inside of the frame, and as close to the low pressure cylinder as practicable, is a high pressure cylinder, the revolving and reciprocating parts of which connect with an inside crank. It is to be noticed that the inside crank is diametrically opposite to the outside crank.

By the arrangement described, all revolving parts are balanced by revolving weights, and all reciprocating parts by reciprocating weights. The following is a description of the manner in which this is accomplished: The rear wheel has only revolving parts connected with the crank pin, and the counterbalance in this wheel is made sufficient for these parts alone. As there is no excess balance in this wheel, the condition of perfect equilibrium is maintained undisturbed.

While the conditions affecting the main wheel are somewhat more complicated, they are nevertheless quite as perfectly dealt with. The revolving parts (Fig. 9), attached to the outside crank pins, are perfectly balanced by the revolving counterbalance in the wheel, and the reciprocating parts attached to this crank pin have absolutely no balance in the wheel. Again, the revolving parts attached to the inside crank are perfectly balanced by revolving parts attached to these cranks. The reciprocating parts connected with the inside crank have no balance in the wheel. That is, the revolving parts attached to the crank pins are in each case balanced by revolving counterweights, which enter into the design of the wheels and cranks. The main wheel has no excess balance.

The reciprocating parts connecting with the outside crank pin are unbalanced, so far as this crank pin is concerned, and the similar parts connecting with the inside crank pin are unbalanced so far as the crank pin is concerned; but these two unbalanced elements are designed to be equal, and, being connected with crank pins which are diametrically opposite, their motion is opposite, and hence they hold each other in equilibrium. One is a balance for the other. As, therefore, the reciprocating parts are completely balanced, there are no forces to "jig the train," and as no use is made of "excess balance," there is no "vertical component" to act upon the wheel and to vary its pressure upon the rail.

These statements are based upon the truth of the principle which appears to be fundamental in the design. As the actual weight of the parts involved is not available, the statements cannot be demonstrated numerically, but the tests already described go to indicate that, having adopted a correct principle, the designer made no mistake in the development of details.

THE EXPERIMENTS.

In carrying out the experiment with the balanced locomotive some difficulty was experienced in guiding the wire between the driver and its supporting wheel—a difficulty due to the fact that the treads of the drivers were coned, while the face of the supporting wheels were straight, the line of contact between them, as measured across their face, being, as a consequence, very short. For this reason it sometimes happened that a wire, which had been started, would roll out from under the wheel, either partially or entirely, and thus present a variable thickness. It is evident, however, that irregularities resulting from this cause would occur at random; that is, they would have no definite relation with definite phases of the wheel's motion, and in making comparison all such wires have been thrown out.

A defect of another sort also appears in some of the wires. It happened that the wires which were first used proved to be so hard that they impressed themselves slightly into the face of the wheels. Wires, which were afterward sent through, occasionally followed at intervals along their length the very slight grooves which the previous wires had formed, and when this occurred the wire is flattened less than at other portions of its length. But there is no occasion for false conclusions from this cause, since in every case the impress of the groove is clearly traced upon the wires, sections containing this defect being similar to that shown by Fig. 10.

THE WIRES.

In the course of the experiments a large number of wires were run under the several wheels experimented upon. Many of these were calipered at 2 inch intervals throughout their length and the dimensions thus formed were plotted to scale.

[The plotted thicknesses of 16 of these wires are given in the report, and the actual wires accompany the report as appendices. The appendices include the following: Wires obtained while the engine was running at a speed of 38·1 miles an hour (190 revolutions per minute); wires obtained while the engine was running at a speed of 49·5 miles an hour (247 revolutions per minute); wires obtained while the engine was running at a speed of 53·9 miles an hour (269 revolutions per minute); wires obtained while the engine was running at a speed of 60·1 miles an hour (299 revolutions per minute); several copper wires, all from the left forward driver, obtained at speeds which were between 55 and 60 miles per hour. In explanation of the comparative diagram, Fig. 11, the thickness of the wires is represented by the distance of the heavy sinuous line from the base, the distances being 50 times greater on the diagram than in the actual wires. The thickness of the wire as plotted as compared with its length as plotted is 600 times greater than the thickness of the actual wire is to the length of the actual wire. These proportions have been chosen for the purpose of exaggerating on paper the variation in the thickness found in the actual wire.—EDS.]

The significance of the results already described is emphasized by comparing them with results obtained in similar manner and under similar conditions from an engine of the ordinary type. Such a comparison is made in Fig. 11. The diagram of the wire from the balanced engine, which appears in this figure, is not shown elsewhere, but that of the wires from the ordinary engine is taken from Fig. 8, changed in scale and as to the direction of wheel motion.

The diameter of the drivers for the balanced engines is 67·4 inches, and for the ordinary engine 62·5 inches, so that while the number of revolutions per minute for the latter is somewhat greater than for the balanced engine, the speed in miles per hour is less. These differences, however, are too slight to impair the value of the comparison. The original wires were, in both cases, of practically the same size.

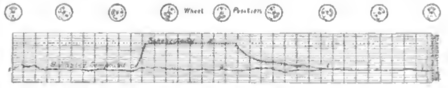


FIG. 11.—COMPARISON OF WIRES TAKEN FROM LOCOMOTIVES SCHENECTADY No. 1 AND BALANCED COMPOUND—DOTTED LINE SHOWS ORIGINAL DIAMETER OF WIRES.

The one important difference in condition is to be found in the fact that the wheel of the ordinary engine carried 400 pounds excess balance, while that of the balanced engine, as already explained, had no excess balance. The result is that while the wire from the balanced engine is nearly of the same thickness throughout, that from the ordinary engine increases in thickness as the counterbalance in the wheel approaches the upper quarter, until its full diameter is reached; a condition which continues through several feet of its length, and makes plain the fact that the wheel must have risen clear of its support during a considerable portion of its revolution.

The conclusions already recited seem, therefore, to be fully justified by the data upon which they are based, which conclusions are, in effect, that the drive wheels of the balanced locomotive are at all times in perfect balance, that they neither increase nor diminish the pressure with which they act upon the rails as they revolve, except as they may be acted upon by accidental

causes; and that all the oscillations of the locomotive are very much less than those which attend the action of a locomotive as ordinarily balanced.

THE STRENGTH OF LADDERS.*

To those who spend a dozen hours a week underground, as well as to the miner with his ten hours a day, the strength of ladders is of great interest, and on occasion may become supreme. To quiet apprehensions on this score, and to furnish a basis of judgment as well, the following tests were made, and if any excuse for them be called for, on the ground of crudity or incompleteness, it will be amply given if others, with better facilities for such tests, be persuaded to take the question up.

The ladders tested were of the common "Bull" pine of the Sierra region ("black pine," Pinus Jeffreyi), the sides of 2 in. × 4 in. rough lumber, fairly clear, and the slats of 1 in. × 4 in. nailed on and not notched in. The width of the ladder and the length of step were 12 in. In such a ladder, when new, the strength of the slats would exceed the resistance of the nails, so that it would fail by the pulling off of the slats. Assuming a vertical position for the ladder, the maximum angle of a man's arm in climbing would be included by 45° out from the vertical, which would also represent the maximum tendency toward pulling off to which the slats would be subjected. In accordance with these premises, the tests were made by placing the ladder at an angle of 45° against a support, with the slats on the lower side, and weighting the slats to the point of rupture or detachment by means of steelyards. The results are shown in the table.

TABLE OF LADDER TESTS.

Ladder.	Age, years.	Condition of wood.	Nails, 12 penny.	No. of tests.	Weight of cubic foot of wood.	Pull. Max., lb.	Pull. Min., lb.	Pull. Av., lb.	Remarks.
A	New	Green	Wire	3	24·6	886	600	725	Slats all pulled.
B	"	"	Cut	3	24·6	1,534	1,075	1,324	" " "
E	½	Very wet	Wire	6	23·2	933	612	750	3 slats broke with warning. 1 " " without warning. 2 " pulled with warning.
C	1	Wet	Cut	5	22·6	1,101	811	979	3 slats broke with warning. 1 " " without warning. 1 " pulled with slight warning.
D	1	Damp	"	7	23·1	1,188	356	721	5 slats broke without warning. 1 slat pulled with warning. 1 side broke " "
G	1	Very dry	Wire	6	25·3	464	226	310	All pulled with warning from 2 to 30 seconds.
F	5	Dry	Cut	2	21·7	663	403	584	1 slat broke without warning. 1 " " with slight warning.
F	3	"	"	3	21·7	1,227	709	987	Made on three-year-old slats on same ladder. 1 slat pulled without warning. 1 " broke " " 1 " " with "
G	1	Very dry	Wire	4	25·3	1,345	1,082	1,248	Made on slats pulled from G. All broke without warning.

Before proceeding to discuss the general strength of ladders as brought out, it will be found interesting to compare tests A and B, made on ladders of identical condition, save in the kind of nails used. The relative resistances of the two kinds, wire and cut, was found to be practically in the proportion of their respective adhering surfaces. Twelvepenny wire nails, 73 to the pound, present an adhering surface of 0·785 sq. in. each, the point being ignored and 1 in. being subtracted from the length to allow for the thickness of the slat. Twelvepenny cut nails, 47 to the pound, with the same allowance present 1·394 sq. in. each. Their relative resistances are 725 and 1,324 lb. for 6 nails, or 121 and 221 lb. per nail, which reduces to 154 lb. per sq. in. of adhering surface for wire and 159 for cut nails.

In studying the table, the column of "Minimum Pull" is the one to which the most interest attaches, and in that the smallest value is 226 lb., corresponding also to the smallest average of 310 lb. The descriptive data for this test, G, are "one year in use in very dry place" and "nailed with wire nails." These would seem to be the ear marks of the poorest ladder. Referring to the last test in the table, it will be seen that the wood was sound, but brittle from its dryness. The failure of this ladder was due to the shrinking or drawing away of the wood from around the nails. Shrinking produces also the same appearance, and to a certain degree the same effect, as if the nails had started from their places; the shrinking of the slat is toward the nail head, which is grasped by the wood, and that of the sides is away from the slat against the resistance of the nail point. And this gives an obvious means of diagnosing this malady of extreme dryness, and one that can be applied instantly to any ladder.

But the case is different for ladder D, probably the most dangerous, if not the weakest one of the lot. A minimum pull of 356 lb., and five slats breaking with no warning, make a very dangerous combination. Casual scrutiny, such as one would naturally give to his surroundings on ascending an unfamiliar ladder way, would reveal the weakness of G, but not of D.

From general appearance F would have been classed as the weakest ladder of the lot, so that its record is surprising, and it is quite worth bearing in mind that prolonged dryness is not the worst condition for timber. Returning to a further consideration of D and G, we should also note that taking into account the foot pressure, G is probably as strong as any in the list. In an average man the chord of his arm, bent in climbing, measures 30 in. from center of shoulder to palm of hand, and 60 in. is the distance from center of shoulder to ball of foot. With the foot placed 72 in. below the hand, the pull of the hand is [illegible] of his whole weight, and the thrust of the foot [illegible] of it. With an assumed weight of 200 lb., the pull and thrust are 35 and 166 lb. respectively. On this basis G presents, as factors of safety, 4 for pull and 6 for thrust; D, on the other hand, presents 6 for pull and 2 for thrust, with the additional danger of no warning before rupture. When we come to inclined ladders, the danger of pulling off becomes less, and G drops from the dangerous list.

The points that stand out from the foregoing are three: The weaker ladder is the very dry one; the most dangerous ladder is the damp one; the strongest ladder is the new one put together with cut nails. As a whole, the study is reassuring, and goes to account for the infrequency of accidents from the failure of ladders. As a corollary the following may be suggested: For dry places use dry lumber and notch the slats in flush; for damp places make heavier slats.

* Written for the Engineering and Mining Journal by Robert Gilman Brown.

THE AUTOMATIC IGNITION OF GAS.

In commenting on this subject the Journal of Gas Lighting says that devices of various kinds for automatically lighting gas burners have been introduced from time to time; and in a recent number of the Journal fur Gasbeleuchtung, the chemist of the Berlin Gas Works, Herr H. Drehschmidt, has described the more successful of them. He begins by pointing out that the facility with which an electric lamp is ignited and extinguished has been one of the most prominent advantages of electricity over gas for lighting purposes; and he says the stress of competition has compelled attention to appliances for placing gas on an equality with electricity in this respect. It is probable that electricity will eventually come to the aid of gas; but the electrical devices for igniting gas automatically have so far been either large and ugly, or else complicated, and therefore unreliable. Other appliances are at present simpler and cheaper.

In the apparatus devised by Duke, he took advantage of the well known property possessed by platinum sponge of glowing in a current of hydrogen and air. Coal gas contains as great a volume of other constituents as of hydrogen; but these do not excite the sponge. In a mixture of hydrogen and air, the sponge glows with sufficient intensity to ignite the gas; but it does not ignite a mixture of coal gas and air. Rosenfeld showed, however, that coal gas and air caused the sponge to glow to a certain extent, and that a platinum wire attached to the sponge could be thus warmed. It was then raised to incandescence by the gaseous mixture, which it ignited. Rosenfeld's discovery was comparatively useless, because the sponge was found to become dense and inactive by repeated use. Duke, however, made a preparation of platinum to which this objection did not apply. He saturated meerschaum or similar porous material with a solution of platinum chloride, and dried it in a stream of hydrogen or coal gas at a temperature not exceeding 212° F. The platinum was thus reduced and deposited in a very finely divided condition on the material. It may be parenthetically remarked that platinized pumice, similarly prepared by the reduction of platinum perchloride, is well known in this country by users of Harcourt's method of estimating sulphur in gas. Porous material thus coated with platinum, used in conjunction with a projecting thin platinum wire, made a very durable and efficient appliance for automatically igniting a flat flame burner as soon as the gas tap was turned on. A little care was needed in attaching the appliance to the burner in such a position that it was exposed to the mixture of gas and air; and consequently careful handling was necessary to prevent derangement. But with moderate attention, this appliance remained operative for a long period. Ammonia and sulphureted hydrogen and vapors of carbon disulphide temporarily destroyed its activity.

The appliance was not so readily adapted to incandescent gas burners, and the first attempts to utilize it were unsuccessful. If it was suspended from the rim of the chimney, or attached to the top of the mantle fork, so that it was immediately above the mantle, it was subjected to the action of the hot gases from the flame, and was injured thereby. If placed above a pilot jet at the side of the mantle, some means of extinguishing the jet as soon as the burner was lighted was needed; and a tap which provided for this required in practice such careful manipulation that its general employment was out of the question. It was essential to success that a simple turn of a tap should complete the operation; and the patent taken out by the Greek Canellopoulos, which has been acquired by a company in Berlin, first described a means of accomplishing this result. According to the specification, an abstract of which recently appeared in the Journal, the flame of the burner heats a solid, liquid, or gaseous body in such a manner that the supply to the pilot jet is thereby automatically cut off so long as the burner itself is in use. One method of achieving the object of the inventor was to take advantage of the expansion of a confined volume of air in a tubular chamber set up near the mantle. The lower end of the tube was sealed by mercury, and the expansion of the confined air by the heat of the burner flame forced the mercury up the small gas pipe which fed the pilot jet, and thus cut off the flow to the latter. The supply to both burner and jet was controlled by one tap, and therefore on opening the latter the gas flowed to both simultaneously. The pilot jet was ignited by means of Duke's device, as described for flat flame burners; but before the flame could be communicated to the burner, a considerable quantity of gas had flowed out, and formed an explosive mixture within the chimney. The ignition of this mixture by the pilot jet injured the mantle.

It was therefore necessary that the gas should only begin to flow to the burner after the pilot jet was already ignited by means of Duke's appliance. The firm of Ludwig Loewe & Company made an improved apparatus, also depending on the principle of expansion as set out in the patent of Canellopoulos. They, however, used a platinum wire in place of confined air as the expanding body. The platinum wire was suspended from a hook alongside the mantle, and adjacent to the flame of the pilot jet. Its lower end supported one end of a lever, the other end of which was attached to the plug of a two-way valve on the gas pipe. When the wire was cold and taut, the plug was held so that it closed the way to the burner, and left open that to the pilot jet. If then the gas tap was opened, the gas only flowed to the pilot jet, and was there ignited by Duke's device. Then the heat of the flame of the jet slightly expanded the platinum wire, and thus the way to the burner was slightly opened. The gas which then flowed from the burner ignited from the flash light, and the heat of the burner flame farther expanded the wire. The way to the burner was thus opened to its full bore, while that to the jet was completely closed, and the light extinguished. This appliance, of course, depends for primary ignition on the proper action of the platinized meerschaum and the platinum wire as used by Duke; and it therefore fails with oil gas or other gas that contains little free hydrogen.

After the extinction of the burner, a short time must elapse before re-ignition is attempted, as it is essential that the platinum wire which operates the valve should be cold when the gas is first turned on. On account of the slow flow from the pilot jet, the distance from the tap to the burner or burners supplied should not be more than about 25 feet. If it is more, the interval of time between turning on the tap and ignition is very great. One tap may control several burners, provided each is fitted with the device for automatic ignition.

AMERICAN HORSES FOR GERMANY.

The following has been received from Vice-Consul Sonon, dated Hanover, June 1, 1897:

For about two years, efforts have been made to introduce American horses into Germany. At first great difficulties had to be overcome. The accommodations on the ships were not good; a large percentage died during the voyage, and the rest arrived in such bad condition that the whole lot had to remain in quarantine for several weeks. The freight and other expenses of transportation were high, and last, but not least, the horses were not the kind needed in Germany and hence were not sold at profitable prices. Now, however, some ships of the Hamburg and Bremen lines are fitted out expressly for this service. The freight is lower—$25 per horse, I am told—and the man attending the horses is taken over and returned free of charge. The accommodations are so perfect that the horses arrive here in good condition. The loss on the voyage is reduced to from 2 to 4 per cent. The result is they are permitted to be landed without quarantine. The number of horses sent to Hamburg is much larger than the number sent to Bremen. The unloading at the former port is more convenient, as they can go from the ship directly to the pier, while in Bremerhaven or Nordenhamm, the ports for the larger Bremen steamers, the horses have to be lightered ashore.

The American horses which sell most readily in the German market are thickset working animals of the Percheron breed, with short, specially heavy legs. Until lately, this variety was mostly imported from Belgium. The home demand there, however, has become so great that horses of full growth are at once bought, leaving only young colts to be exported. Danish horses, large numbers of which are imported into Germany, are used for tramways and stages; they are not so heavy as the Percheron breed.

The hoofs of the American horses lately imported are pronounced better than those of the Belgian horses.

Buyers of American horses have made two complaints: They say that the animals, not being accustomed to the food generally given to horses in this country (oats and wheat bran), lose flesh, and that it is several months before they are again in good condition. If American breeders who intend to export horses to Germany should feed the animals some months before they are shipped, as well as on the passage, with oats instead of corn, the animals would remain in good condition. Buyers further complain that the majority of the horses are not broken to harness.

American horses have been sold here lately at prices ranging from $225 to $300 a head.

The demand in Germany is, next after the class above named, greatest for showy, high-stepping horses, in contrast to the American fast trotter; the supply has of late come from Hungary.

Hanover at one time was pronounced to be the best horse market in Germany. It has since lost that standing, though it would be well for importers by way of Hamburg or Bremen to keep an eye on this market.

Army horses are almost exclusively raised in Germany, being bought when young—two to three years old—and kept in the several supply stations (Remonte-depots) until fit for service. They are regarded as needing at that age a special diet; the training, on the other hand, is given in the various regiments, a year or somewhat less being allowed for this purpose.

ENGINEERING NOTES.

Stiffened cement has been used successfully in the construction of a boat by an Italian named Gabellini. The frame is of steel bars a third of an inch in diameter, over which is spread a wire netting. On this the cement is laid and the outer surface is polished. The boat is heavier than one built of wood would be, but is cheaper and slips better through the water. Experiments have proved its strength.

The following are the compositions of some of the most prized of the Japanese copper alloys: 100 parts of copper with from 1 to 10 parts of gold constitute the varieties of shadko, which is colored bluish black with copper sulphate, alum and copper oxide. The gray quisibuishi contains, besides copper, some 30 to 50 per cent. of silver. Sinchu, the best Japanese brass, consists of 100 parts copper, 50 parts zinc, and lastly a bell metal is made up of 100 parts copper, 15 parts zinc, 40 parts tin, and 5 parts of iron.—Prometheus.

The three new steamers built for the Japanese line Toyokisen Kaisha by English shipbuilders are of a construction hitherto unknown in Eastern Asia. They differ from the twelve boats building now for the Nippon Yushee Kaisha in this respect, that they are passenger boats, while the twelve are freight steamers. The speed of the three new steamers is to be 17½ knots per hour, so that they will be faster than the boats of the Canadian Empress line, to the present time the fastest and most comfortable line in those seas. The journey across the Pacific will take twelve days, as against seventeen, which is the present length of the trip.—Uhland's Wochenschrift.

The following paragraph seems familiar—rather more familiar than the steel: We know that "wootz," or Indian steel, was one of the items of the tribute paid by Porus to Alexander the Great. This much prized metal the patient Hindu still produces by his primitive methods, and in a crucible no larger than a chimney pot, over a rude clay furnace fanned by a goat skin bellows, fuses from the ore a small "bloom," or lump of steel, of a quality unattained by European metallurgy. The fuel used is very pure charcoal, and in the crucible is put some chopped wood of Cassia auriculata with green leaves of Convolvulus laurifolia and of the ak or mudar (Calotropis gigantea), a large Asclepiad. Thus was produced the raw material of the famous Damascus sword blades, and from it native armorers still forge weapons of the finest temper, and possibly drills as hard as Mr. Maxim's.—Delhi Morning Post.

The English firm Armstrong & Company has built to order of the Russian government a powerful steamer of peculiar construction. It is intended to ferry passengers and freight of the Trans-Siberian railway over the Baikal lake. Since that lake is covered with ice several feet thick during a considerable period every year, the boat is built so as to be able to break through the ice. At the beginning of 1896 the order was given, and in June of the same year the hull of the vessel was already completed and taken apart again for transport. This undertaking is unique in its kind—a ship of 4,200 tons built in less than six months, taken apart, packed on an ocean steamer, and sent to St. Petersburg. From there it was transported to the terminus of the Siberian railroad, and thence to its destination by sledge. The putting together of the boat was superintended by an engineer appointed by the Russian authorities, and acquainted with the art of shipbuilding.—Uhland's Wochenschrift.

The resistance to fire offered by wrought iron pillars recently engaged the attention of a commission appointed by the Hamburg Senate. The report just issued states that such columns withstand fire very imperfectly, their stability being quite destroyed at a temperature of about 600° C., and the advantage of filling them with concrete is very slight. The case is, however, far different with outer coatings of refractory or non-conducting materials, which have proved capable of protecting the metal from a dangerously high temperature during a certain space of time, and, consequently, of affording effective protection against fire. The substances which appear to have exerted the best effect are the cork composition of Herren T. Gautzweig und Hartmann, and xylolite incased in sheet iron, which substances give out inflammable gases for two hours and a half, leaving a carbonaceous residue that is not destroyed by the steam from the fire hose. A pillar thus coated only gives way after being exposed to the fire for four hours, while seventeen minutes suffice to destroy it if uncoated when similarly heated. Next to the above named substances comes the Monier concrete, laid on in a coat of 1½ inch thickness, which preserves iron for nearly two hours and a half, while plaster of Paris and asbestos cement only gave poor results.—Invention.

The story of a remarkable engineering feat in California is told by the Chicago Railway Review. A great section of mountain was recently torn off by 10,000 pounds of powder, lifted several feet straight up and then pushed bodily forward 40 or 50 feet, tumbling over the gorge below the dam and then falling with an awful roar 125 feet, to remain hereafter for all time as the bulwark of the great dam being built to impound water for the city of San Francisco. The dam is 43 miles east of the city. For two months or more preparations had been made for the monster blast, in common with another blast that is nearly ready. The plan was to cut tunnels into the side of the mountain at various points above the bed of the creek and to place in these tunnels first great stores of black powder, which ignites slower than giant powder, and, therefore, it has more pushing power and less shattering effect. On the surface and in places through the mountain side were placed big deposits of giant powder for the purpose of shattering the mass and lifting it up. According to plans, the black powder when it exploded would hurl the mass straight forward, making a bridge of granite across the gorge and blocking the stream. The plans were carried out with the greatest care and with a successful result. When the dust cleared away, it was found that the blast had dislodged a mass of rock 400 feet up and down stream and an average of 60 feet in height, completely bridging the canyon. The engineers estimated that the amount dislodged weighed about 150,000 tons. The rock was thrown exactly as the engineers had planned.

ELECTRICAL NOTES.

The steam tramway from Cassel to Wilhelmshöhe has been bought by Siemens & Halske, and is henceforth to be replaced by electrically propelled cars.—Uhland's Wochenschrift.

An improvement that should prove useful on diving dress is a telephone transmitter attached to the helmet, placing the driver in direct communication with his helpmates above.—Revue de l'Electricité.

A second submarine cable was laid from England to France on May 8. It strikes the British shore west of Dover, and France west of Calais. A third cable is going to be laid by the French Government.—Revue de l'Electricité.

In England the total number of subscribers on the telephone lines was 8,000 in 1885, and increased to 13,000 in 1886. In the same year fifty-nine supplementary offices have been opened, and the total number of communications has risen to 350,000,000.—L'Electricien.

In July of this year boats propelled by electricity were experimentally run on the Spree, at Berlin. The elegant boats are built by the Hagener Accumulatorenfabrik, and carry 30 passengers. They effect a communication between the Exchange and the Richard Wagner Strasse. There will be five stopping places, and the whole fare will be 10 pfennig, i. e., about 2½ cent.—Uhland's Wochenschrift.

A writing pen provided with a small electric lamp has lately been patented in Germany and Austria. By this device it is said that the paper in front of the writer is kept well lighted, the disagreeable shadow of the pen being altogether done away with. The invention would scarcely seem simple enough to come into general use; how such a pen would work in the dark can be found out by trial only.—Wiener Gewerbe Zeitung.

The Russo-Belgian Electrical Company has recently obtained, jointly with the Helios Company, of Cologne, and the Russian Lighting Company, at St. Petersburg, the sole right of laying in the Russian capital cables for supplying private houses with electricity for lighting purposes. This concession implies enormous privileges. The share of the Belgian company alone comprises the installation of 100,000 lamps.—L'Energie Electrique.

In fairly strong rain the moistened surface of the earth may be used as a conductor for telegraphic purposes; a double conducting system, i. e., a whole circuit, may sometimes be obtained by using for one conductor the surface moisture, and for the other the well water under ground. It seems, however, the experiments made in this direction can have no practical application, as the connection can only be used under rare circumstances.—Prometheus.

A block signal system has been tried in the great thoroughfares of London (England). The contrivance consists of a high mast, on which the police officer in charge may at will hoist a sign with the word "stop." At night the signal is lighted by electricity. The arrangement is simple, and seems to work very well. It ought to prove very useful not only in preventing dead-locks in the traffic, but also in opening a path for fire engines and public processions, etc.—Uhland's Wochenschrift.

It has often been noticed that high chimney stacks are only rarely struck by lightning. By statistics, such exceptional cases occur three times in 10,000, while steeples are struck 60 times, windmills even 80 times out of the same number of cases. The fact is explained by the discharge which the ascending smoke continually keeps up. In some places it is customary to light a big fire on the approach of a thunderstorm. The origin of this may lie in the same quarter.—Der Stein der Weisen.

At the Victoria Station, Manchester, England, baggage to the weight of 1,500 lb. is transported by a combination of suspended electric cars and electric elevators. The work is done with wonderful rapidity and has, so far, led to no accidents or disorder of any kind. On account of its simplicity, speed and safety this system should prove extremely useful, and worth being adopted in other places where heavy weights are transported over short distances.—Monatschrift für Oeffentlichen Baudienst.

The lead fuses of Fischer Hinnen recall the magnetic blow-pipe and the lightning arrester of Siemens & Halske, which quickly interrupts any arc. According to the description, apparently by its inventor, in Eclairage Electrique, the fuse wire is wound in the deep grooves of a porcelain bar; the grooves are sharp-cornered, and have a depth of one inch. The porcelain is hollow, and contains a soft iron core with pole plates above and below. At the lower extremity is a terminal from which the spiral lead wire starts; the other end of the lead wire is attached to the upper plate, so that the current returns through the iron core and the pole plates. A long fuse can thus be applied, and the winding of the wire around, though in series with the iron core, makes the iron an electro magnet, which blows out any arc formed. The one test mentioned is not particularly convincing, but the fuse, if not too heavy and cumbrous, may well answer its purpose.

The following statistics, giving the number of motors connected to the mains of the Berlin Electricity Works, have just been published, says The Engineer: In all 1,098 motors are connected, aggregating 6,110 horse power. Of these, 372, corresponding to 1,379 horse power, work presses; 333 motors, or 1,900 horse power, are used for lifts; 226 motors, or 177 horse power, for ventilators; 196 motors, or 645 horse power, for machine tools for metal working; 77 motors, or 311 horse power, for woodworking machines; 74 motors, or 283 horse power, for grinders and polishers; 62 motors, aggregating 197 horse power, are used in paper works; 57 motors, or 192 horse power, for sausage machines; 21 motors, or 20 horse power, are used by color manufacturers; and 18 motors, or 25 horse power, drive sewing machines. In addition to these are 29 washing machines, 13 ironing machines, 11 leatherworking machines, and 13 machines for electrotyping purposes, aggregating 43 horse power; 3 motors, or 63 horse power, for driving dynamos, and 205 motors for various purposes, requiring together 636 horse power.

SELECTED FORMULÆ.

Bug Exterminators.—Below follow a few formulas for bed bug exterminators, as recommended in various quarters:

Benzin Compound.—

Colocynth	5 g.
Insect powder	5 "
Benzin	100 "

Buchheister's Bed Bug Exterminator.—

Tobacco	100 g.
Insect powder	100 "
Carbolic acid	75 "
Boric acid	25 "
Oil citronella	4 "

Borosalicylic Solution.—

Sodium borosalicylate	20 g.
Water or quassia decoction (5:100)	100 "
Spirit lavender	50 "

Picric Acid Mixture.—

Picric acid	5 g.
Stearic acid	10 "
Paraffin	10 "
Oil clove	5 "
Kerosene	250 "

Hager's Bed Bug (Paste) Powder.—

Persian insect powder	100 g.
Pellitory	100 "
Carbolic acid	5 "
Oil citronella	5 "
Dilute alcohol	enough.

Make a thin paste, which is to be brushed into the cracks.

A heroic remedy is the following, recommended some time ago in the SCIENTIFIC AMERICAN, viz.:

Arsenic	2 ounces.
Corrosive sublimate	¼ "
Venetian red	¼ "
Lard	13 "

The next is also from the same source, but is indorsed no more than the preceding:

Corrosive sublimate	1 ounce.
Muriatic acid	2 "
Water	4 "
Decoction of tobacco	16 "
Oil of turpentine	16 "

Liquid bug exterminators are usually applied with a brush, but a much better method is to employ a machinist's oil can, a fair substitute for which is a bottle in the perforated cork of which is inserted a quill.

A few words about the bed bug itself may not be inopportune. The cimex, or more properly acanthia lectularia belongs to the division of insects known as hemiptera (half winged), subdivision heteroptera (dissimilar-winged), although few people suspect that they are first cousins to the equally vengeful mosquito. Heteroptera are characterized by two dissimilar pairs of wings, but in the house bug these wings are wanting or extremely abortive. Blood is not their sole nourishment, but in case of necessity they content themselves with various vegetable juices; however, they can live a very long time without food, when they become almost transparent. The female is supposed to deposit its eggs—about 50 at a time—in the alternate months of March, May, July and September, the young brood requiring eleven weeks to mature. The vigorous individuals of the September series live through the winter, the greatest cold being unable to kill them.

Aristoteles taught that house bugs are generated in the perspiration, but they are supposed to have been introduced from India. In the latter country they must surely be luxuriating, since in hospitals a bug trap is a necessity, this trap being a board full of minute bore holes which is placed beneath the mattress, whence it is removed from time to time to be scalded.—Western Druggist.

Plating Aluminum.—To plate aluminum with gold, silver or nickel, by the galvanic process, it is necessary to first coat the article with a covering of copper. This is best done as follows: First wash the metal thoroughly in a solution of soda, then carefully remove all the soda by immersing the article in running water; next place it in hot hydrochloric acid, diluted to contain 5 per cent. of acid. Wash again and put into copper sulphate solution, slightly acidulated. When a thin cover of metallic copper has formed, the aluminum is ready for galvano plating—but must first be washed.—Wiener Gewerbe Zeitung.

Liquid Starch Gloss.—

Distilled water, fluid measure	100 parts.
Borax, by weight	10 "
Gum arabic, by weight	10 "
Spermaceti wax, by weight	10 "
Glycerine, by weight	27 "

½ per cent. oil of lavender.

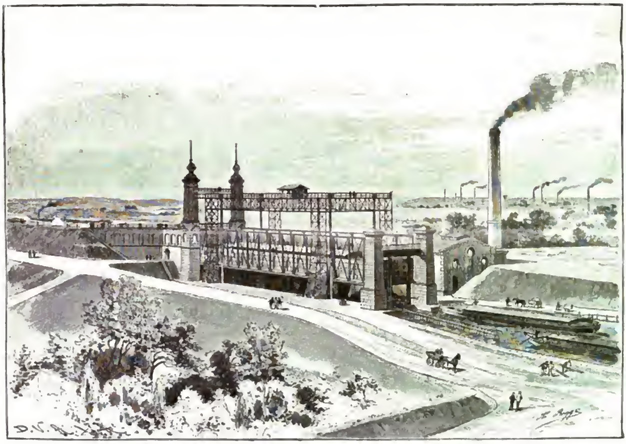
Dissolve the borax in water, and then dissolve the gum in this solution, and gently warm it sufficiently to dissolve the wax. Then put the whole into a warm stoneware mortar, and rub up the whole until the wax has emulsified, i. e., formed a creamlike emulsion, with the fluid. Then gradually add the essential oil, and finally stir in the glycerine, being careful to stir all the while it is being added, so as not to cause the separation of the components. Some little skill is required in forming an emulsion, for, if not properly done, the ingredients will separate on standing or on the addition of water. In a properly formed emulsion no such separation will occur. One secret of success consists in stirring the mixture always in one direction, say from left to right. Never reverse the stirring process, or you will assuredly cause separation of the constituents. Another secret is to maintain the temperature constant until the last morsel of wax has entered into combination—it is only a physical, not a chemical one—with the other ingredients. In the last formula the glycerine may be dispensed with if desired. The directions for use are to be: One teaspoonful of the liquid gloss added to each pint of boiling hot starch made in the usual way, and the fabric starched in the usual way. Or the linen may be first starched in the usual way with plain starch, and then a rag dipped in the gloss, squeezed out, and lightly smeared over the starched portion, and the ironing proceeded with as usual.—Pharmaceutical Era.

THE DORTMUND-EMS CANAL.

OF all Germany, Westphalia is one of the most favored provinces. In the east and north fertile fields and rich orchards extend far and wide over the land, liberally yielding their treasure, while in the mountains that rise from the banks of the Sieg and Ruhr lie hidden coal and iron, the foundations of industrial prosperity. The valley of the Sau, on the other hand, the Switzerland of Westphalia, delights the traveler with its vast oak forests and pine woods. Nature has greatly blessed the country, but one thing it has been denied: no great river pours its crystal wave through the land, opening a path whereon the merchant vessel may carry the riches of the land away over buoyant waters to the northern market. But where the hand of Nature has not provided, man's skill must be called to aid. For years it had been purposed to build a canal to connect the industrial center of Westphalia with the North Sea. Only lately this plan came into execution, some forty years after its promulgation, forty years which must have caused a large pecuniary loss to the German province. At the present time the great canal is completed, and henceforth, no doubt, Westphalian industry will flourish more than ever.

A silver streak, the Dortmund-Ems canal, extends from east to west through green meadows and dark forests, here and there with a pretty cottage reflecting in its waters. The mountainous nature of the soil has in many places called the engineer to work. Numerous bridges and viaducts cross the canal.

The Lippe bridge at Oelfen, in particular, is a masterpiece of engineering. It is nearly 49 feet broad and 227½ feet long. Many obstacles had to be removed, many structures to be erected to render the plan of a canal practicable. The most imposing and the greatest of such is the one we give an illustration of. At Heinrichenburg the level of the canal changes by some 45 feet, and the transferring of the barges from one portion to the other is contrived by an ingenious elevator system. It will give our readers some idea of the vastness of the machinery if we mention that the length of the moving reservoir for the barges is 245 feet. Our illustration shows it lifting a barge, the work being just half completed. Under the reservoir there are five floats, which are firmly attached to the reservoir by steel beams, and which are wholly immersed in water. The upthrust of the floats is exactly equal to the pressure due to the weight of the reservoir, etc., so that a small force is able to lift reservoir and barge to the higher level. This giant structure is remarkable as the greatest and, technically, most perfect of all similar mechanisms in the world. Our illustration is taken from Ueber Land und Meer.



THE SHIP ELEVATOR AT HEINRICHENBURG, ON THE DORTMUND-EMS CANAL.

THE UTILIZATION OF ALUMINUM IN THE ARTS.

UNDER the above title Alfred E. Hunt, president of the Pittsburg Reduction Company, delivered before the Franklin Institute, Philadelphia, a lecture from which the following excerpts are taken.

Until within ten years it was believed that if any one should be fortunate enough to produce aluminum so as to retail it at $1 a pound, the consumption of the metal would be enormous; and that if it could be sold at fifty cents a pound, the demand for the metal would be prodigious.

Early in the progress of the Pittsburg Reduction Company my attention was called by the necessities of the case to the fact that the problems connected with the sale of aluminum, its adaptability for various purposes and the progress of the utilization of the metal, were as intricate as the problem of the cheaper production, and required as much research, offering a great many more opportunities for remuneration than would the search for cheaper methods of production. The perfecting of details in the higher processes as carried on at Niagara Falls, Pittsburg and Kensington have already allowed the aluminum to be sold at 31 and 32 cents per pound in ingots, while the relative price in sheets over ingots is not greater than that charged for copper and brass. Copper sheet has a specific gravity of 8·93; brass sheet, 8·15 to 8·20; aluminum sheet runs 2·62 to 2·66; so that copper is $3\frac{4}{10}$ times and brass $3\frac{14}{100}$ times heavier than aluminum.

The output of aluminum in the United States in 1896 was about 1,300,000 pounds, and the output for 1897 will be about 2,000 tons; and I estimate a consumption of only about 1,000 net tons in the United States.

The uses of aluminum have enlarged very much in the past eight years; and from a consumption of not over 100 pounds per annum and selling at not less than $8 a pound, it has increased to 100 tons in 1896.

One of the most important uses of aluminum has been its utilization in the manufacture of steel ingots and steel castings. Many attempts have been made to alloy aluminum with iron and steel; but no very satisfactory results have been so far obtained. The influence of aluminum seems to be as a softener rather than a hardener of iron. Aluminum combines with iron in all proportions; but an alloy of 50 per cent. aluminum and 50 per cent. of iron, while casting into a solid mass, will crumble into powder in a very short time. Aluminum is largely used in the manufacture of steel; but the amount is very small and varies with the steel being made, the amount of occluded gases and the temperature of the molten metal. It is put into the ingot mould, or groups of moulds, until the proper proportion has been determined, starting with two ounces to the ton of steel and increasing to four or five ounces to the ton, according to the result desired. Bessemer steel requires one to three ounces more per ton than open hearth metal to produce the same effect. The special advantages to be gained by the use of aluminum in steel manufacture are as follows: First, increasing the soundness of the tops of the ingots, with consequent decrease of scrap (saving loss); second, quieting the ebullition in molten steel, thereby allowing the successful pouring earlier than otherwise; third, adding to the homogeneity of the steel by preventing oxygenation, also by decreasing the time the steel will remain fluid after being poured into the moulds, preventing the central core from hardening longer than the outside portions of the metal. It increases the tensile strength of the metal without decreasing the ductility.

Good steel has been made, using aluminum entirely, instead of manganese. The use of aluminum insures smooth surfaces in castings and ingots. Its use increases the soundness of the fibers of steel ingots and decreases the scrap and other loss. This use of aluminum in the manufacture of steel is adopted almost universally with the principal steel manufacturers, not only in this country but in Europe. The phenomenon of quieting ebullition is a very important one. Steel would ordinarily boil from ten to fifteen minutes before freezing over; and when freezing would rise from eight to ten inches, if ordinary steel, unless something heavy were placed on the top of the ingots. When aluminum is added, the steel will freeze over within thirty to forty-five seconds. There is danger of adding too large a quantity, in which case the metal would form too solidly and create deep pipes in the ingots; the shrinkage due to contraction producing pipes occasioning a serious amount of crop ends. No difficulty has been experienced with mixing aluminum with steel, as it seems to thoroughly permeate the metal without any special stirring.

Prof. Arnold has shown that the blow-holes in steel are primarily caused by carbonic oxide in the metal. Aluminum is the principal deoxidizer known to metallurgists, the next being silicon. One hundred parts by weight of oxygen will combine with fourteen parts of aluminum or 350 parts of manganese. This does not correctly express the deoxidizing power of aluminum; as it has such a great affinity for oxygen that the latter will entirely disappear where aluminum is present. There is also an additional inducement to use aluminum; for the silicon will add about $1 to the cost per ton of steel, while aluminum will not add over 10 cents to the cost per ton.

Some manufacturers use ferro-aluminum, this being a trade name given to 5, 10, 20 per cent. alloy with iron. Most users of ferro-aluminum make their own ferro by adding known weights of aluminum to known weights of steel cast in convenient moulds. In cast iron, one to two pounds of the metal is put into the iron as it is being poured from the cupola into the melting furnace. Where there are difficult castings to be made, or where the iron will not flow well, aluminum certainly, in many cases, has allowed of better work being done and stronger and sounder castings being made. The effect of aluminum in wrought iron is not very marked. It seems to add somewhat to the strength of the iron, but the amount is not sufficient to induce the general use of aluminum for this purpose.

Aluminum, either pure or alloyed, is sold upon the market by the dealers now in the form of ingots, bars, plates, sheets, rod, wire, tubing and castings. Among the alloys, there are several kinds of purposes for which it is to be employed. The principal hardeners are copper, nickel, zinc, manganese, titanium, tungsten and vanadium. It has been found practicable to combine several of these metals in the different forms, rather than using them singly to form alloys.

The ordinary commercial aluminum contains over 99 per cent. of pure aluminum. Casting aluminum can be very much improved in rigidity and tensile strength if afterward subjected to drop forging processes. One of the particular uses of aluminum at the present time is in the fabrication of aluminum cooking utensils, for which it is well adapted by reason of its lightness, resistance to corrosion, ease of keeping clean, and high specific heat. It is made up in the form of cast hollow ware and stamped or spun.

In shaping aluminum wares better work can be obtained by the stamping process. The spinning operation being of such a character as to spread apart the metal, a much more open surface for corrosion is exhibited than when stamped.

One of the great advantages of aluminum is that the salts occasioned by its corrosion are not in any way

poisonous. It may be kept clean from corrosion by the same care bestowed on brass or other bright work.

Pure aluminum is not as readily corroded as the alloys of the metal. With imperfectly made aluminum there is sometimes metallic sodium alloyed with it. Its presence occasions rapid corrosion, that is, corrosion of the sodium in the aluminum leaving the aluminum of such porous character that it corrodes much more rapidly.

Aluminum is receiving extended use in chemical laboratories, in water baths, Bunsen burners, hot water filters, and condenser tubes.

(To be continued.)

ELECTRIC PLOWING.

OUR grandfathers plowed with oxen and horses, and at that remote epoch in which the railway and the telegraph had not as yet perturbed the existence of farmers they derived much benefit from this slow but sure process of labor, the traditional character of which flattered their conservative instinct. But, with the progress of the transportation industry, competition made its appearance, and it became necessary to recognize the fact that animal power was not everywhere and always the most economical and rational as regards plowing. So the larger cultivators have had no hesitancy for the last thirty years in having recourse to the various systems of steam plows, the many advantages of which have long been universally known. We say large cultivators, because, while recognizing the excellence of the mechanical process brought into play by his rich neighbor, the plowman of small or moderate means hesitated about spending the amount of money necessary to purchase steam plowing apparatus and to keep it in repair. At present, therefore, although the steam plow is in common use in farming on a large scale, it is almost entirely excluded from exploitations whose importance is not of the first order.

But where steam has not been able to succeed completely, electricity might well prove an economical solution of the problem of plowing. The first trials of the application of electricity in this direction are due to M. Felix, of Sermaize, who a few years ago conceived the idea of substituting a dynamo for a locomotive steam engine for plowing purposes. In this system the expenses were too high, and it is only quite recently that the Messrs. Zimmermann, of Halle, have devised an arrangement that permits of a much more economical use of electric power. They produce electricity by means of a locomotive apparatus that may be placed upon a road or at any point whatever of a field, and carry the energy through cables to a receiving dynamo that forms part of the plow and produces the displacement of the latter. Let us say at once that in farming on a large scale in which steam engines of high power are used, and in sugar works, distilleries and other agricultural works dependent upon the direct exploitation of the soil, it is advantageous to make use of these for actuating the dynamo. Setting aside these large installations in which there exist powerful stationary engines, and also those in which are found waterfalls capable of yielding the necessary power in the vicinity of the fields to be plowed, we are going to see in what consists the arrangement normally necessary for electric plowing. As we have already said, if the generating source of the current changes, it is merely necessary to modify the wiring that conducts the energy, and the principle of the method is not altered.

An endeavor has been made, in the first place, to make the apparatus light, so that the farm animals can haul them without difficulty to the points where they are to be employed, and to permit of the use of the agricultural locomotives that are employed for other purposes, so that the capital invested shall not be increased. The following is the arrangement that has been decided upon:

The plow is of the tilting type, and carries a dynamo. Upon the shaft of the latter there is mounted a double gearing that transmits motion to a second shaft, upon which is keyed a wheel, which guides a chain that is stretched over the field to be plowed and is anchored at its two extremities. When the motor is thrown into gear it draws upon the chain and causes the plow to move forward. At the end of the course the plow is tilted and the direction of the current reversed, and the plow returns to the other extremity in unwinding the chain. The anchors that fix the two extremities of the latter are maneuvered by means of a simple lever upon which the action of one man suffices to pull them up.

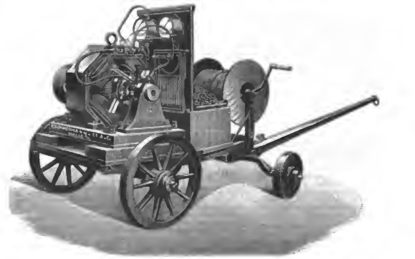


FIG. 1.—A GENERATING DYNAMO MOUNTED UPON A CARRIAGE FOR ELECTRIC PLOWING.

In small and medium cultures, any 12 or 15 horse power locomotive may be used. The generating dynamo is placed upon a wagon which, in the displacements, is coupled to the locomotive. When a person reaches the place where he wishes to install his source of energy, it suffices to connect the flywheels of the motor and dynamo by a belt. The only condition that the locomotive has to fulfill is that of having a very sensitive regulator, as, in fact, is required in every engine that actuates a dynamo.

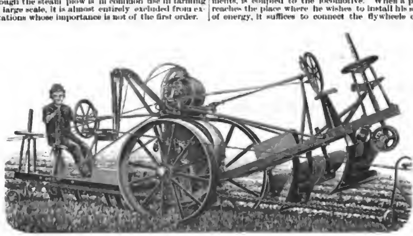


FIG. 2.—THE ELECTRIC PLOW OPERATING IN A FIELD.

The transmission of the electric energy is effected by means of wires corresponding to the two poles of the dynamo and supported by poles through the intermedium of insulators, just exactly as in a telegraph line. The poles are placed along the edge of the field at right angles with the direction that the plow is to follow. In order to take the current from these wires, two trolleys are employed, and these are connected with wires parallel with the travel of the plow. These wires at the two ends are wound around tension carriages and supported here and there by small carriages that participate in the shiftings of the plow. The wires, supported and stretched, as has just been seen, rest upon two special contacts carried by an arm that forms part of the plow. They thus transmit the current to the receiving dynamo through the resistance box. It is this same arm carrying the contacts that lifts the carriages and arranges them at the desired distance apart to effect the return of the plow. The plow is provided with two shares, each preceded by a small colter. It may be completed by scarifiers that stir up the earth to a depth of sixteen inches without turning it over, while the shares plow to a depth of about ten inches. The plow moves forward at the rate of 230 feet a minute.

The installation of the material requires half a day's work; but the time thus employed is soon compensated for by the acceleration obtained in the operation of plowing. Experiments made in Germany have shown that it is possible to plow more than four acres to a depth of ten inches in ten hours. To do the same work in the same time by the old method, it would require four teams of six oxen. The latter walk at a speed of scarcely more than fifty feet a minute.

For heavy soil it would be necessary to construct plows of a somewhat different style, but the installation would be practically the same. The power necessary varies according to the nature of the soil.

In farming on a large scale, in which it is necessary to plow to a greater depth (to fourteen instead of ten inches), and in which it is also necessary to plow from eight to twelve acres per day of ten hours, the installations include, as a general thing, stationary engines and a transmission of energy through coarse wires of polished copper, like those of telegraph lines. The rest is arranged as above stated, with the exception of a few details.

It is estimated that the expense of electric plowing is only about half of that of steam. This is a fine result, and we think that M. Maguin, who is constructing the Zimmermann material in France, will find numerous customers.—La Vie Scientifique.

ADVICE TO BUILDERS OF ELECTRIC RAILWAYS.

By G. WHITEFIELD CHANCE.

As president, manager or superintendent of a railway system, you are interested in motors, brakes, coal bills, salaries of employes, and most of all, earnings. You try to figure down your operating expenses, but, perhaps, like the famous ghost, they will not down. You are looking for leaks. Can you see prospective dividends vanishing before inevitable repairs and renewals?

What do you think of a large city system of electric roads with a nine inch girder rail, under a traffic of 450 car trips per day, after three years' service, crying through motors, cars and riders, for reconstruction. And yet this is only one case out of scores where material was all right but handling all wrong. You are an able financier and manager, but perhaps are handicapped by the lack of foresight of someone.

Roadbed.—In interurban railroad building along country roads, the question of drainage is most important; so also in cities this is an important question, except with good foundation and practically watertight pavement, or where the track is laid on concrete. Often a cheap line of drain tile is as effective as a foot of stone ballast. Especially on comparatively light traffic roads designed to be built cheaply will correct drainage treatment show marked saving. Experience on steam roads has taught us that we dare not obstruct nature, and yet how often is precedent thrown aside? To fully appreciate the value of drain tile one must have lived in or visited "the drain tile States."

Concreting.—There is more money thrown away in bad foundation work than is generally realized. But this special part of your track work is frequently a case of "the devil take the hindermost." If you are laying rails in cities, where excavation is required, no more material should be taken out than is absolutely necessary to get in the foundations. Some work is very loosely done in this respect; a solid bottom should be insisted on in any case. If you are laying where the roadbed can be rolled, it should be done by all means. If heavy traffic is the word, concrete first, last and all the time, and perhaps you may do away with ties entirely, if the conditions are favorable.

Ties.—There are two standard ties in this country, white oak and yellow pine. I have learned, as we all have who have had much to do with the question, that there are ties and ties, and that a competent inspector will save a small fortune to a large company. How many roads in building or even in renewals get what their specifications call for? While there are two standard woods, others may be used in certain localities by using good judgment as to traffic and local conditions, and then comes in the question of the tie plate, its advisability and form, questions again of suiting your appliances to your conditions. A cypress or cedar tie with a tie plate, in certain localities, may be much better and more expedient than a harder wood. A tie plate, even with hardwood ties, is a great saver with heavy traffic or tortuous alignment. Yet again, it may be unnecessary with easy alignment and light traffic. Timber treatment, creosoting and kyanizing are well known methods of increasing the life of the tie and may be used with judgment in certain cases.

Rails.—There has been much written about rails, chemical composition, length, form, etc. For nearly all purposes of track construction, the long rail, preferably the 60 foot rail, has come to stay. The broad, shallow head, high web and moderately wide base give the best results. Where tie plates are to be used, we would naturally use a moderately wide base, but the market forms will have to govern the selection in most cases. The American Society rail or T rail work is good and practical. All the high girders by the principal American mills are good in practice, but the foreign girders are generally of bad head design. Perhaps a rail with greater base width than common would give better results when laid directly on concrete. The chemical composition, heat treatment, and mill inspection are points too little looked after in giving rail contracts. High carbon, low phosphorus and sulphur with a proper heat treatment is the "battle cry" for good rails. It is entirely reasonable to allow a harder, even if more brittle, rail in sheet girder work than in steam work, where a broken rail may mean loss of life and property.

Joints.—These should be good, or none at all; that is, your rail can be practically continuous if you bury

it in rigid paving. We are not yet to the point of laying continuous rail in open track, although recent experiments with cast joint continuous rail seem to point that way. By laying so as to make the stress generally one of tension, with perhaps a slight compressive one at times, and using proper anchorages at curves, we may attain to a continuous rail in open track. But when you must have a joint, let it be the best. If you are using a low rail, use a heavier joint plate in proportion than with a high rail. I would much prefer a joint plate of the type that drops below the base for a T rail, or a combined tie and joint plate. The mistake is nearly general in using a small joint plate with a small rail, with the consequence of a bad track, surface bent rails and general inefficiency. The poor fish splice used with light rails has done more to condemn the rail than the rail itself. My own experience and that of many experts has demonstrated the fact that light rails wear proportionately better than those of heavier section. This is explained by the fact that the head of a light rail gets more work done on it by the rolls and is of a denser construction. In the matter of continuous rails the cast joint is cheaper than the electric weld, by something less than half, a nine inch cast weld joint costing about $3.50, while an electric weld of the same rail costs about $5 per joint.

Bonding.—Whatever style it be, copper, plastic alloy, electric or brazing weld, let it be well done, to which end thorough inspection is necessary, for as with all track work, we usually say good-bye to this part of the system when the "fliers-in" come along. With the cast joint there is a difference of opinion as to the necessity for bonding, some bonding their joints and others maintaining this unnecessary. However, if the right means are at hand, the cast joint can probably be made electrically sound.

Special Work.—Having been engaged in the manufacture of special work for some time, I may here add a word or two of interest and value. We have frogs and crossings now with hard centers—manganese, Harveyized and case-hardened. They are all good and fastened about the same in the first two cases. We have also solid cast steel pieces which are well made. While certain pieces of one manufacture will outwear those of another manufacture in a certain locality, the difference on the average is slight, and great difference of wear can generally be traced to non-uniformity of product. On this account, a guarantee from the maker is in order. The trouble with this class of work is that it is more or less going through the experimental stage. Where you have curves of very sharp radius with heavy traffic, a special steel should be considered. Manganese is the best yet found. Your curves should of course have easements, and the outer rail should be elevated if possible. All curve rails, whether T or girder, of less than 500 feet radius, should be bent at the mill, and if of heavy section, up to 750 feet radius. Switches and mates are also made with special steels in tongues and central wearing parts. These are the best, but for light traffic the less expensive styles will do; however, all depends on how light the traffic is.

Bridges and Culverts.—The number of bridge accidents on suburban trolley lines has been too great. Don't take any risk; you cannot afford to, even if you are operating a cheap line, for if you lose a bridge and a few lives culpably, where will dividends for years go to? Better err on the side of safety, if you must err, but with competent supervision and careful inspection there should be no erring and indeed no unreasonable expense. A guarantee or insurance may relieve you of pecuniary responsibility, but for the good name of your road you cannot afford to have accidents. "Sufficiency" is the word. Don't try to make water run up hill. Give it room.

Overhead Line Work and Conduits.—Your pole line, frogs, conduits, etc., should be good construction and standard practice. There are so many electrical nostrums in the way of overhead fixtures that it takes some care to select the best for the money expended. Poles should be set in concrete. Compressed mica insulators are the best. Creosoted wooden ducts for cables are standard. When the third rail system can be used, it is best and cheapest.

Motive Power.—You may be pleased and edified to note the progress made in compressed air, gas, steam, and other motors, but experience teaches, and it has not yet demonstrated these motors to be superior for urban and ordinary suburban service. The accumulator car, and compressed air motors, are worthy of study, and in certain situations these motive powers may yet find a field.

Power Stations.—The subject of location is both a mathematical and ordinary financial one, and should be left largely to the engineer. For a first-class plant of large units compound condensing engines, water tube boilers, automatic stokers, economizers and direct connected generators are the essentials of economical operation. For a small plant, high speed automatic engines, with belted generators, give good results, while the automatic stoker and economizer may be dispensed with. The subject of pure water supply, purifiers, heaters, pumps, separators and condensers are details that must be worked out in each case.

Cars.—For urban service the single truck car is best, for fast interurban service the double truck car has many advantages. The simpler the truck the better, provided the principle is all right. For fast service something more than the hand brake should be used. The air brake and electric disk brake are both available. The latter has been brought to a state of perfection that will probably meet all requirements, and it possesses the advantage of a direct method of application of power.

Operation.—There is entirely too much looseness in methods of operation of electric interurban roads. For single track lines, either a dispatcher system with orders should be used or an electric train staff system or automatic block. With double track lines an automatic electric block system will meet all requirements.—Western Electrician.

Steiger (Corres. Bl. f. Schw. Aerzte, May 15, 1897) found that of about twenty thousand eyes of children in the primary classes in the schools of Zurich, 1570 were more or less defective. About one-half of these, or 777, were astigmatic. In some of these the affection was light, but in 662 it was described as considerable, while in 318 it was marked.

NUTRITIVE VALUE OF FOOD.

In order to ascertain the customs and methods of persons of different stations in life regarding the purchase and use of their food, a series of investigations are being conducted by the Department of Agriculture. These inquiries are of a distinctly practical character, and they are made with the co-operation of a number of experiment stations, colleges, and other organizations, as well as of private individuals, in different parts of the country. The general scope of the investigations includes the determination of the amounts and nutritive value of the food consumed by a given number of persons during a certain number of days, and the deducting of the quantities per man per day.

It is believed that such information, coupled with that derived from the study of the composition, digestibility, and nutritive value of food materials in common use on the one hand, and with that which comes from research into the laws of nutrition on the other hand, will gradually make it possible to judge what are the more common dietary errors and how improvements may be made to the advantage of health, purse and home life. A variety of digestion experiments have already been made, and others are in progress under governmental supervision. Accounts of studies of dietaries of families, boarding houses and clubs are from time to time made the subject of official reports.

HOW EXPERIMENTS ARE MADE.

In these studies account is taken of the amounts, composition, and cost of all food materials of nutritive value in the house at the beginning, purchased during and remaining at the end of each experiment, and of all the kitchen and table wastes. Such accessories as baking powder, essences, salt, condiments, tea, coffee, etc., although of interest from a pecuniary standpoint, are of no practical value as regards nutriment. The sum of the different food materials on hand at the beginning and those received during the experiment is taken, and from this sum the quantities remaining at the end are subtracted, thus giving the amount of each material actually used. From the amount thus obtained and the composition of each material, as shown by analysis, the amounts of the nutritive ingredients are estimated. From these are subtracted the amounts of nutrients in the waste, and thus the amounts of nutrients actually eaten are learned. In all of these experimental inquiries account is kept of the meals taken by the different members of the family and by visitors. The number of meals for one man, to which the total number of actual meals taken is equivalent, is estimated upon the basis of the potential energy. These energy equivalents are somewhat arbitrary, and it is acknowledged that they will require revision in the light of accumulating information.

Following is a table of estimated relative quantities of potential energy in nutrients required by persons of different classes:

Man at moderate work	1·0
Woman at moderate work	0·8
Boy between 14 and 16, inclusive	0·8
Girl between 14 and 16, inclusive	0·7
Child between 10 and 13, inclusive	0·6
Child between 6 and 9, inclusive	0·5
Child between 2 and 5, inclusive	0·4
Child under 2	0·3

WHERE STUDIES HAVE BEEN MADE.

The dietary studies already made include a boarding house, a blacksmith's family, a jeweler's family, a chemist's family, an infant nine months old, a college students' eating club, a Swedish laborer's family, a female college students' club, farmer's family, a camping party in Maine, a poor widow's family, a man in the Adirondacks under treatment for consumption, and a mason's family.

As a general thing, the figures used for the percentages of nutrients in each food material are taken from the averages given for like food materials in Bulletin No. 28 of the Office of Experiment Stations of the Department of Agriculture.

The figures in that bulletin represent the results of a compilation of analyses made previous to January 1, 1895. In estimating the fuel values of the nutritive ingredients, the proteine and carbohydrates are assumed to contain 4·1 and the fats 9·3 calories of potential energy per gramme. These correspond to 1,860 calories for one pound of proteine, or carbohydrates, and 4,220 calories for one pound of fats.

FUEL VALUES OF BACON, TURKEY AND COD.

Bacon has a very large percentage of fuel value. The latest official analysis shows that a portion of bacon, with the inedible parts discarded, contains 17·8 parts water, 9·8 parts proteine, 68 parts fat, and 4·4 parts ash, and has a fuel value of 3,030 calories per pound. By the same analysis, the edible portion of a turkey is found to contain 55·5 parts water, 26 parts proteine, 22·9 parts fat, and 1 part ash, with a fuel value of 1,350 calories per pound. Codfish, edible portion, contains 82·6 parts water, 15·8 parts proteine, 0·4 part fat, and 1·2 parts ash, and has a fuel value of 310 calories per pound.

In each of the dietary studies reported the data regarding the kinds and amounts of food material, the persons by whom they were eaten, and the number of days and meals were sent to the Government Experiment Station at Middletown, Conn., where the necessary computations were made. For the sake of simplicity and convenience, the computed quantities for one man for ten days are given, instead of the actual quantities consumed, or the quantities for one man for one day. If the quantities were stated as actually consumed in the period of each dietary, it would not be easy to compare the quantities in different dietaries. By putting the quantities for all of the dietaries on one basis, however, the relative amounts of the different kinds of food materials, as meats, milk, bread and the like, in the different dietaries are readily compared. If the quantities were given per man per day, some would be too small for printing without the use of an inconvenient number of decimal places.

WHAT A LABORER'S FAMILY ATE.

A fourteen days' study was given to the dietary of a laborer's family in Hartford, Conn. The family consisted of man and wife, three girls, aged respectively four, six, and eleven years; a boy, two and a half years old, and an infant. The father was a laborer in a coal yard, earning $8 per week. The mother had worked as a servant before her marriage and did her own cooking. The food materials bought by this family consisted of beef, veal, mutton, pork, salt codfish, eggs, butter, milk, rice, flour, rolled oats, bread, beans, sugar, potatoes, onions and raisins. The consumption of food, calculated for one man ten days, was: 13·2 pounds of animal food, 9·6 pounds of cereals and sugars, 11·1 pounds of vegetables, and 2 pounds of fruit—a total of 34·1 pounds. This total quantity cost $1.63, and it contained 2·41 pounds of proteine, 2·24 pounds of fat, and 9·59 pounds of carbohydrates, the aggregate fuel value being 31,700 calories per pound. The following table shows the nutrients and potential energy in the food purchased, rejected, and eaten by this entire family during the period of fourteen days:

FOR FAMILY, 14 DAYS—FOOD PURCHASED.

Food materials.	Cost.	Nutrients. Proteine. Grms.	Fat. Grms.	Carbohydrates. Grms.	Fuel Value. Calories.
Animal	$5 62	3,312	5,239	1,076	66,710
Vegetable	3 51	2,816	444	23,519	112,100
Total	$9 13	6,128	5,683	24,595	178,810
* Total	..	38	99	98	1,480
† Total	9 13	6,090	5,584	24,497	177,330

* Waste.
† Food actually eaten.

PER MAN PER DAY—FOOD PURCHASED.

	Cost.	Proteine.	Fat.	Carbohydrates.	Fuel Value.
Animal	$0 10	59	94	15	1,175
Vegetable	0 06	50	8	420	2,000
Total	0 16	109	102	435	3,175
* Total	..	1	2	2	30
† Total	0 16	108	100	433	3,165

* Waste.
† Food actually eaten.

WHAT A CAMPING PARTY REQUIRED.

In the summer of 1895, four young men, from nineteen to twenty-two years of age, spent some time in canoeing and camping on the Allagash River, in Maine. As they took their journey leisurely, they may be considered as being engaged in light work. The whole time included in the dietary study of this party is estimated as equivalent to 115 days for one man. The following table shows the nutrients and potential energy in the food purchased, rejected and eaten by this camping party:

FOOD MATERIALS.

Food materials for party.	Nutrients. Proteine. Grms.	Fat. Grms.	Carbohydrates. Grms.	Fuel Value. Calories.
Food purchased:				
Animal	12,169	27,396	2,331	314,230
Vegetable	7,616	2,625	59,018	297,610
Total	19,785	30,021	61,349	611,840

PER MAN PER DAY.

	Proteine.	Fat.	Carbohydrates.	Fuel Value.
Food purchased:				
Animal	106	238	20	2,730
Vegetable	66	23	513	2,590
Total	172	261	533	5,320

The average of thirty-eight dietaries recorded by the government officials makes the following interesting showing:

DIETARIES.

Dietaries.	Nutrients. Proteine. Grms.	Fat. Grms.	Carbohydrates. Grms.	Fuel Value. Calories.
Food purchased	111	140	447	3,595
Food waste	7	11	13	185
Food eaten	104	129	434	3,410
Estimated digestible nutrients in food eaten	96	124	423	3,285

CHARACTER OF SANDOW'S FOOD.

About a year ago, during an engagement of Eugene Sandow, the "strong man," in Washington, an attempt was made to determine the character and amount of the food he consumed. Mr. Sandow claims to be the strongest man in the world, and at the time of the investigation he had the appearance of being in perfect health. He did not then follow any prescribed diet, but ate whatever he desired, always being careful, as is his custom, to eat less than he craved. He always ate very slowly. He smoked a great deal, and drank beer and other beverages. Below is the result of a study of Sandow's dietary for one day:

Food consumed (Quantities in ounces.)	Nutrients. Proteine.	Fat.	Carbohydrates.	Potential energy.
	Lb.	Lb.	Lb.	Cal.
Dinner January 18. 8 oysters, 10 soup, 1 celery, 3 fish, 1 potatoes, 2 oyster plant, 1 green peas, 1 tomatoes, 2 bread, 2 roast beef, 2½ chicken, 4 ice cream, 3 orange sherbet, ½ cakes, 1 butter, 11 wine (Burgundy)	0 17	0·14	0 34	..
Supper. 8 roast beef, 7¼ rye bread, 3½ Camembert cheese, 3 water biscuit, 3½ cakes, 4·1 lb. beer	0 36	0 14	0 61	..
Breakfast, January 11. 9 vegetable soup, 2 potatoes, 3 veal (deviled chops), ½ green peas, 2 roast beef, 3½ bread pudding, ½ cakes, 14 beer	0 11	0 05	0 16	..
Total in pounds	0 54	0 33	1 11	4462
Total in grammes	244	151	502	..

It was noted that Sandow rejected all of the visible fat of the meat served him, and in his case it was shown that while the amount of carbohydrates and fat consumed did not differ very greatly from the standard

for a man at muscular work, the amount of proteine (albumen) was very large. The fact that so much proteine was consumed by Sandow sustains the theory advanced by scientific experimenters that the energy which is used in the production of severe muscular labor is furnished by the combustion of proteine.

Official experiments regarding the digestibility of food by healthy men are now in progress. It has been demonstrated that 98 per cent. of the proteine and 97 per cent. of the fat in animal foods is readily digested; also that 85 per cent. of the proteine and 90 per cent. of the fat in cereals and sugars, and 80 per cent. of the proteine and 90 per cent. of the fat in vegetables and fruits is readily digested.

DO WE TAKE TOO MUCH ACID FOOD?

THE affirmative of this question is strongly maintained by Dr. W. T. English, Pittsburg, in a paper read on June 3 before the Section on Physiology and Dietetics of the American Medical Association, at its annual meeting in Philadelphia, and published in the Medical News (July 17), from which we quote the following paragraphs. The writer begins by noting that, instead of confining our use of acid fruits and vegetables to the summer months, as Nature intended, we now eat them all the year round. He says:

"It would be impossible within the scope of this paper to refer to the individual products concerned in the ever-increasing list of acid foods consumed in this country. Let a few suffice. Tomatoes, which depend for their flavor upon a peculiar acid (acidum lycopersicum), have rapidly grown in favor, until, from comparative obscurity, they have reached the head of the list. It has been estimated that during the years intervening since 1890 this vegetable has multiplied in production ten times.

"Each week during 1885 it required twenty five carloads of lemons to supply the city of New York. At the present time the daily demand exceeds that amount. This is true of other cities, and for the most part the country demand is proportionately augmented. Oranges are supplied in about the same relatively increased quantity. Limes are the most keenly acid of all fruits. Almost unknown outside the fashionable drinking halls five years ago, to-day they are a commodity. They are imported pickled as well as fresh, and the bottled juice comes to this country in large quantities from the West Indies. Congress has recently placed a special tax upon this fruit, because of its large importation. The grateful acid of the rhubarb leaf, in conjunction with binoxalate of potash, with the malic acid contained in gooseberries, currants, cherries, plums, apples, and pears, adds to the acidulous tide.

"Recently it was learned from a large commission merchant that apples, to be salable in our markets, must be decidedly acid. Sweet apples are employed only in making cider and vinegar. Some varieties of the small sweet fruit have almost disappeared, and their places have been filled by those that are tart enough to please the present acid taste. . . .

"It is claimed that the cheapness of sugar permits the consumption of acid fruits which otherwise would be distasteful. The ingenuity displayed in bringing acid into a condition to make it palatable serves to prove the increasing tenacity of the acid habit. Sweet and neutral vegetables, as beets, cabbage, lettuce, etc., are often rendered acid in order to give to them the much desired sour flavor. Forty thousand tons of cucumbers are raised and eaten within the limits of the United States each year, and this affords an excuse for the employment of about 1,000,000 gallons of vinegar and acid sauces or condiments. The large pickle factories that began with the decade have been reinforced by new establishments and additions that double their capacity for sending out acid products. The demand for piquant sauces has caused a large special industry to arise within the twelve years now ending. Meanwhile the home culinary department has augmented its capacity as to quantity and variety. A considerable amount of salicylic and boracic acids contributes to the preservation of fruits. . . .

"The realm of acid ingesta geometrically expands when we enter the domain of drinks. In the drinking halls the casual observers cannot fail to be impressed with the tendency to indulge in acid beverages that are of recent origin, while those of more or less remote popularity still occupy their position as to quantity consumed. But if the question were asked to-day as to what is the national drink, it would be answered by the fizz of the soda fountain. . . . Foreign countries know little about the American soda fountain, but it increases the acid consumption one hundredfold in this country. The most profitable and largest part of the druggist's trade to-day is that of the product of the soda fountain. Mineral and vegetable sours contribute to the tide of acids which enter the stomach from this source. . . . Small lunches are supplied at some soda counters, consisting of hot tomato and clam bouillons, beef tea, cocoa, chocolate, coffee, tea, ice cream soda, cake, crackers, etc. The most common demand, however, is for the acid-flavored drinks, including mineral and vegetable acids, with water charged with carbonic acid gas. . . .

"All this obtains, too, in spite of the fact that acids are naturally rejected in early childhood, and only rendered tolerable or agreeable by acquired appetite. The increased consumption of acid foods and drinks cannot be accounted for by the increased population, for it is out of all proportion to its growth. Indeed, our population during the last decade has remained almost stationary, while the acid demand is increasing in geometric ratio each year. The consumption of acid foods has increased out of proportion to all other foods, and the amount of acid drinks ingested has doubled every year since 1890.

"This extending and increasing appetite for acid foods and drinks is evidenced by the self-conscious need that many feel for antacids to counteract acidity of the stomach. Wherever sour drinks are sold there are also the antacid, as bicarbonate of soda, magnesia, etc., on hand for the accommodation of those who cannot uninterruptedly continue the acid pace. Again, medical men will admit that the trend of therapeutics is forced, however unconsciously, into the antacid and antifermentative realm. This is not only because of the introduction of sour acids, but is also due to the fact that the acid conditions favor the development of micro-organisms and promote fermentative conditions in the body. These micro-organisms are always more injurious in their effects than the acids that are used as foods and drinks.

"The various modifications of the digestive function incident to the excessive use of acid foods and drinks are already with us, and the acidulous habits of the body mark a stage in civilization. These facts, stated in connection with the estimates above made, should satisfy all that the acid appetite fostered and gratified is contrary to physiologic law. It may further be argued, however, that the acids employed are not only unfavorable to proper digestion, but that they directly and indirectly modify the chemic composition of the blood and bodily fluids."

We have not space to follow Dr. English as he traces the influence of this excess of acid through all the nutritive processes, when, according to his view, it neutralizes the alkalies in the bile and pancreatic juice, thus rendering them of no effect, and similarly destroys the alkalinity of other bodily fluids, including the blood, which to insure immunity against infection should be normally alkaline. We close with his final paragraph, in which he suggests that the effects of an acid diet may be even more far-reaching than this and may include the sphere presided over by the brain. After noting that when the alkalinity of the serum is reduced the red blood corpuscles contract and lose their vitality, he says:

"It must be remembered that the red blood corpuscles are the servants of the respiratory apparatus, and by this interference with their office there must be a reduction of the efficiency of the functions of respiration. The sympathetic nervous system is influenced by hyperacidity, and causes in turn a general functional derangement of the organs, notably the heart. The intellect is temporarily confused, and in some this confusion reaches out into incoherence of thought and action. The moral influence of these perturbed conditions of heart and mind extend to and pervert the imagination, and in extreme cases leave their permanent impress."

SNUFF INEBRIETY.

IT is a well-known fact that a large number of persons use tobacco snuff to excess.

In some sections of the country this addiction is very general, and prominent in the marked degeneration of the victims.

The narcotic effects of tobacco used as snuff seem to cause a profound depression of all the senses, and the body generally. The higher psychical life appears to suffer most, manifest in loss of pride of character and appearance, diminished ambition to excel in any work, disregard of surroundings and opinions of others. Later, delusions of persecution and injury, with suspicion and doubts of anything that is true.

A form of low general dementia follows, terminating in death from melancholy or acute disease.

Recently another form of snuff taking, in which cocaine is the central drug used, has come into prominence. Cocaine is given for some of the distressing catarrhs and nasal troubles which are so painful. Its narcotic action on an inflamed mucous membrane is very marked, and is quickly followed by a certain fascination to continue the drug which is difficult to control. The possibility of not being able to give up the drug never occurs until symptoms of obvious poisoning appear, and then, in many cases, the mind has lost all power of appreciating its real condition. Voluntary efforts are usually confined to changing to some other narcotic used by the mouth. The effects of cocaine by the nose, in most cases, differ but little from its use in other ways. Yet there is a certain mental fascination in the inhalation, as in the use of the needle, which is hard to overcome. The delirium and pleasing relief, with mild excitement which follows, make this form of inebriety most attractive.

The rapid exaltations of the sense of comfort and strength, and sudden disappearance of pain and mental fears and worriment, all make a powerful impress on the mind and nerve centers. This for a long time is far more powerful than the depression and suffering which follows.

There can be no question that this form of inebriety exists to a considerable extent in all our large towns and cities. A very sensational story of a large number of persons in a certain Eastern village affected in this way has some foundation in fact. It appears that a certain druggist pushed the sale of a nostrum containing cocaine used in this way, until the demand was very large. The appearance of the toxic effects of cocaine in several persons resulted in an exposure of the danger of the drug, and its sale practically ended. No doubt similar instances are occurring in individual cases where the drug is not abandoned, and cocaine inebriety or other drug taking follows. As a nasal remedy it is exceedingly dangerous, and should be concealed and guarded by the physician with great care. The use by inhalation is more likely to become an addiction than by the mouth or needle. The treatment is surrounded with great difficulties, and often taxes all the resources of the physician to the utmost.—Quarterly Journal of Inebriety.

GERMANY'S INDUSTRIAL GROWTH.

THE following encomium on Germany's recent industrial awakening, especially as applied to the textile manufactures, appears in Kuhlow's German Trade Review:

In the year 1879 industrial Germany may be said to have emerged from infancy into youth. From that year on factory chimneys began to jostle and crowd mediæval castle towers. The brick walls of modern factories began to shut from view venerable piles of masonry whose ages were reckoned by centuries. From that year fair Saxony, on the east, began to throw off her humdrum quiet and assume a textile leadership, while on the west the beauties of the Rhine were gradually clouded by the smoke from factory chimneys. Then, too, began the transition of agricultural into urban populations. Quiet, lethargic market places, whose peace and repose had long been a proud heritage, began to resound with the clatter and tread of hurrying throngs; the hum of machinery began to be heard where before no sounds had greeted the ear but those which accompany the easy movements of a contented rural people.

Textile industries had been going on there for centuries, but they were not the industries of to-day; they were industries which did not call for the aggregation of humanity at any one spot, because they depended on individual rather than mechanical effort.

During several decades preceding 1879 Germany's textile industries had scarcely progressed. They had been locally important, but stationary. She did not even supply the demand of her own markets. While the English free traders were, perhaps, not quite unselfishly, preaching their theories, England was marching forward rapidly, because she had extensive foreign markets scarcely open to any other country. Germany was eager to emulate success and was easily infected. She tried free trade for eight or nine years, only to find herself more dependent on England than ever. During that period it was common to read signs in the store windows of German cities bearing the legend, "English goods sold here," though, perhaps, not so common as it is to-day in England to meet the phrase, "Made in Germany." It seems almost incredible that a little over twenty five years ago the production of cotton fabrics in France exceeded that of Germany, and that only by the acquisition of Alsace and her 2,000,000 spindles was Germany able to take precedence of France in the tabulated statistics of the manufacture of textiles.

Before Germany had thoroughly experimented with free trade, the United States, under protection, had performed marvels in debt paying and had practically accomplished material prosperity. This was an example for the world to copy. In 1879 the Germans determined to cast aside the free trade theories and try protection, and from that year Germany has been an industrial factor to be reckoned with. From a weak and insignificant square on the chessboard of the world, she has moved to an absolutely commanding position.

But while, without a doubt, protection was the moving cause of this industrial revolution, it was not the only cause. Protection to her industries would alone have accomplished little of what has been done in Germany since 1879. To the thoroughness of her methods quite as much as to protection must the change be attributed. German methods were as thorough between 1870 and 1879 as they were immediately after, yet she did not advance industrially in that time. She did not lose, except in competition with England, but she did not advance in comparison with other countries. From the moment her industries were protected Germany's industrial future was assured. She leaped and bounded forward with giant strides, which at first made men wonder and now make nations marvel and admire.

Having so well prospered under protection, Germany turned her attention to extending her markets, since she was able to hold her own at home. She profited by the lesson taught by the United States—that of reciprocity with other nations whose commodities she could take without injuring her own industries. Local sacrifices, of course, were inevitable, but they were as nothing balanced against the gains to the country's trade as a whole. During the two years or so since the conclusion of her treaty of reciprocity with Russia, Germany's textile industries have increased phenomenally. The trade of Saxony, of Crefeld and Elberfeld, and of Eastern Prussia, are notable examples. The textiles from these localities now find their way all over the land of the Czar, where before they were practically unknown.

Of Germany's commercial and industrial methods too much cannot be said in commendation. They are typical of the German character—thorough, enlightened, and the result of close observation and application. There may be some ports her textiles do not reach, but they do not compare in number with the ports where her manufactures have superseded those of other countries. In every country where German textiles are sold they will be found to be as closely adapted to local requirements as is possible, and to be marketed according to local requirements.

Since 1879—as hundreds of our own, as well as English, consular reports are constantly stating—German merchants have thoroughly familiarized themselves with the needs of all the peoples of the world who were willing to purchase German merchandise. They have not accomplished this by sitting in their mills or offices and studying consular reports.

It is considered an essential part of a German manufacturer's commercial education that he speaks several languages, and that he shall have spent some considerable time in travel or residence abroad, where business is being done or may be done.

German manufacturers establish wholesale dry goods houses in all important foreign markets, and are represented therein by agents who speak the language and are familiar with local methods and requirements. In fact, from the moment a German manufacturer of textiles determines to push his products in any particular foreign market, he does it very much as though the goods were made there and everything connected with the business was domestic instead of imported. This, combined with a rigid honesty, true representations, and the expectation of only a reasonable profit, has been the method under which German textiles have gained a strong hold all over the world, where two decades ago they were, if not unheard of, at least unknown.

In the past twelve or thirteen years Germany's trade with some foreign countries has increased tenfold; with most it has more than doubled. And this despite the fact that throughout the textile industry wages have been steadily increasing. Skilled labor in Germany often commands a higher wage than in England, while the labor as a whole is nearly as well paid as in England, and certainly much better paid than it was under free trade in Germany, when the industry was not even supplying the home market. Wages have increased, and hours of labor have decreased.

The thoroughness of the German method begins at the beginning—with the mechanic and the laborer. Without efficient labor to carry out the designs of those who plan, enterprise would exert itself in vain. In the German textile industries the most skilled labor is in most constant demand.

It has been pointed out by Lord Rosebery to Englishmen, and by several advanced thinkers in the United States to Americans, that one of the causes of Germany's success in industrial warfare is the superiority of her system of technical education. Her technical

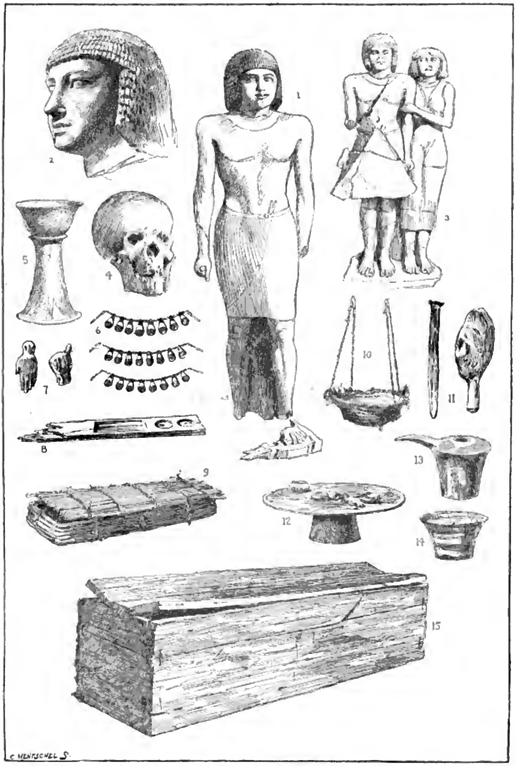
schools will be found in and about every industrial center, and wherever they are found it will be admitted that they have so largely increased the efficiency of the workpeople that equal results could not have been obtained without them.

The technical schools are liberally supported by the state, and they provide the means for all who wish to become expert workmen, instruction being given by day and by night.

But the value of the German method lies as much in her commercial as in her industrial thoroughness. The business is an inheritance from father to son, each in turn endeavoring first to maintain and then to improve the legacy. Johann Esche introduced hosiery knitting into Saxony some two hundred years ago, and that business has descended from father to son to the present day without a break. In another instance there have been only four changes in the personnel of a firm in just one hundred years. The sons of manufacturers are thoroughly trained for their future calling before taking any active part in business. In Saxony, to mention only one center, there are only forty commercial schools where the future merchants are prepared for their successful careers at home and abroad. In these commercial academies the instruction is practical and thorough.

Stock companies are comparatively few. The payment of interest on watered stock and inflated capital is an unknown evil in the German textile industries. Most of the factories are owned by families or small corporations. Enormous profits are not expected, management is frugal, and there is less ostentatious display of wealth, and therefore little greed for the means of making it.

A steel bridge, cantilever, 140 feet in span, to connect the Rue Stephenson, in Paris, with the Rue de la Chapelle, will be put in place over the tracks of the Nord Railroad in a single night without using supports or interfering with the trains.



1, statue of Nenkheftka; 2, portrait of Nenkheftka, a prince and royal priest; 3, group of Nenkheftka and his wife Nefersems; 4, skull of Nenkheftek, son of Nenkheftka; 5, bowl with pottery stand for food offerings in tomb; 6, necklaces; 7, amulets in form of hands; 8, scribe's palette; 9, basket of reeds for the funeral provisions; 10, baskets of palm fiber for carrying earth; 11, mallet and chisel of wood, used for excavating graves; 12, table of diorite, from El Kab; 13, vessel of bronze, from El Kab; 14, alabaster bowl, from El Kab; 15, one of the coffins from Deshasheh that contained the cut-up bodies.

OBJECTS FIVE THOUSAND FIVE HUNDRED YEARS OLD, RECENTLY FOUND AT DESHASHEH, EGYPT, BY PROF. FLINDERS PETRIE.

CANNIBALISM IN ANCIENT EGYPT.

Prof. Flinders Petrie is now exhibiting the result of the explorations he made last winter at a spot called Deshasheh, on the Nile, about fifty miles south of Cairo. He was fortunate enough to come upon a group of tombs which date as far back as the fifth dynasty, about 3500 B. C. In these he found rude coffins with bones in them, but no mummies; an earlier form of burial had been in existence, in which the bodies were cut up, the flesh entirely removed, the bones carefully wrapped up in cloth, and placed in the coffins. The professor comes to the conclusion, based upon statements by Herodotus, Strabo, and other authorities, that the flesh had been cooked and eaten as a sacred rite in connection with the dead. With the Massagetae, when a man reached an old age, it was considered to be a happy and honorable death to be sacrificed and eaten; and it was looked upon as a great misfortune to die before being entitled to this distinc-

tion, for those who died of disease were not treated after this fashion. One of the rude coffins that contained a cut-up body is given among the illustrations. All the objects represented, with the exception of three from El Kab, are from Deshasheh, and they possess a great interest from their extreme antiquity. In one of the tombs a very fine statue was found. It represents a prince and royal priest, named Nenkheftka; a portrait or careful drawing of his head is given, to show what a man was like on the banks of the Nile 5,300 years ago. This statue is good evidence that sculpture was far from being a primitive art at that early date. There is also a group of the same man and his wife, Nefersemu; also the skull of their son, named Nenkheftek. The wooden chisel and mallet, as they would be useless in cutting stone, are supposed to have been employed for excavating the earth in making graves. It may be mentioned that small baskets, like the one shown in the illustration, are still used in India, where women and children carry earth at railway making or other works.—The Illustrated London News.

THE THEATER OF INSECTS.

By John H. Lovell, in Popular Science News.

The first zoological book printed in England was "The Theater of Insects," by Moufet in 1634. The title of the book would suggest that the author, after the manner of old Izaak Walton, was wont to moralize a bit over his studies of natural history. We fancy that he saw, as upon the stage, both tragedy and comedy in the lives and ways of the little known insect world. "The Theater of Insects" differs from all other theaters in that its busy season comes during the summer months. Just as, in the long ago, historical geology tells us that flowers and insects appeared in the world at the same period of time, so now in the early spring the blooming of the first flowers announces the awakening of insect life. If during the last week of the month of May you visit a cold, damp woodland of Northern New England, your attention will at once be arrested by the handsome and conspicuous blossoms of the hobble bush or wayfaring tree. The large flower buds are formed the previous season, pass the winter wholly naked and open in spring with the appearance of the leaves. This shrub may be easily recognized by its straggling habit of growth, its drooping branches, and the broad flat heads, or corymbs, of flowers of two different sizes. The center florets are small, greenish in color, and in autumn produce bright red berries; while the marginal ones, a single row of which surrounds the corymb, are large, white, and sterile. Their size has been increased at the expense of their power of producing seed, and as their use is to attract the attention of insects, they usually open some days in advance of the inner and smaller florets. But for them, the blossom would easily pass unnoticed amid the budding foliage, as may be easily proved by cutting them off. Since their conspicuousness is useless to themselves, but of benefit to the community, they may be said to unconsciously play the part of benefactors.

A sort of barter or exchange is carried on between the flowers of the hobble bush and the insects, by which each is of service to the other. A small quantity of honey, in a thin layer, is secreted by the inner florets, and as insects pass quickly from floret to floret in search of this, their bodies become covered with pollen, and they repay the plant for the food they obtain by effecting cross fertilization. Let us carefully watch the flower on a sunny day and observe how successful it is in attracting insect visitors. I have taken upon it and have now in my collection three species of bees, one butterfly, a small brown species of miller, three hemiptera, five flies, and seven beetles, or twenty species in all, a large number for the month of May. Butterflies are rarely met with, for as the honey is fully exposed and not concealed in a deep pit, as in the pinks, the flowers are adapted only to the visits of short lipped insects such as flies and beetles. Upon the open flowers they can readily obtain both honey and pollen, and in consequence are the most frequent visitors.

In gathering honey from the flowers of the hobble bush there would seem to be no possible danger to insects, and yet they not infrequently meet with a tragic end. Here lying upon the flat top of the blossom is a dead fly. Lift it up and you will discover how it was killed. The head is firmly grasped by the mandibles of a white spider, which, rather than release its prey, permits itself to be dragged from its hiding place and deposited in your collecting box. Except for a red lateral stripe on the abdomen, its color closely resembles that of the flowers amid which it lives, and of whose power of attracting insects it has learned to make use for its own benefit. I have never been able to observe this spider in the act of seizing insects, but I believe it catches them while they are sucking honey. A member of this same family of spiders also frequents the pyramidal flower clusters of the hardhack, and I have known of its capturing so large and strong an insect as the hive bee.

In a previous article I referred to the habit of bees of puncturing the spur of the yellow jewel weed (Impatiens fulva), to obtain the honey more easily than by entering the saclike flower in the legitimate way. In like manner bees puncture the two lipped tubular flowers of the common skullcap (Scutellaria galericulata). In two instances a narrow slit was observed on the upper side of the curved corolla tube, and in a third case the whole upper portion of the tube was cut away, leaving the lips suspended by a mere thread. The buds while still quite immature are also punctured at the apex, usually on the under side. The piercing of nearly mature buds has been recorded of Lamium album, but never before, so far as known to the writer, of the skullcap. The perforation of the flowers of the Labiatæ by bees is, however, of common occurrence. Both the maxillæ and mandibles appear to be employed, the former for piercing and the latter for biting away the tissue, and both the bumble and hive bees are known to make use of the holes in extracting honey. If, after the manner of certain plants famous in myth and story, the Impatiens (fitly, in this respect, named touch-me-not) could speak, what a protest it would utter! For unknown centuries it had been developing the color and form of its flowers, only at last to find its work in danger of being rendered worse than useless by a change in the habits of its bee visitors. It should, however, be mentioned that the flowers in North America are visited by humming birds, and I have also seen another smaller species of bee enter the flower in search of pollen.

THE IGUANAS IN THE ZOO AT LEIPZIG.

Of the many wonders which the Zoological Gardens of Leipzig offer to the gaze of visitors, a pair of fine iguanas form a principal feature, attracting at once the attention of scientists and laymen alike. We reproduce a cut from Illustrirte Zeitung, which their artist drew from life, and which gives a very good idea of the external appearance of the giant lizard—for of the family of the saurians, the iguana is a member.

In technical language, the animal is called Iguana tuberculata, the first part of the name being derived from the language of the natives of Hayti, where iguanas are found; the second, of Latin origin, referring to the excrescences on the head and neck (tuber, a boil, from tumeo).

The head is large and square, the neck is short and strong, the body is long and flattened out sideways, and ends in the long tail, which is covered with sharp scales. All over the body, along the spine, a sharp pointed comb runs from the back of the head to the tip of the tail, giving the beast a dragon like appearance. This is rendered yet more striking by the baggy skinfolds at the throat, which also are set with thorny scales. The whole body is thoroughly protected against the attacks of such enemies as the iguana is likely to meet.

The head is incased in scales which are partly flat, partly convex, lumpy or ridged. The rest of the body has feebly ridged scales. The ears are large and freely attached to the head. The animal often attains a length of 5 feet, over 3 feet of this total being taken up by the tail. This tail is by no means a useless ballast, but is used both as a means of propulsion and for steering when the iguana takes to water, where it is quite as much at home as in the forest. Here, in climbing, in leaping after food from branch to branch and from tree to tree, it avails itself of its strong feet, with their long, sharp claws, and by them becomes a truly dreadful foe to the small birds and lizards of which it occasionally makes a repast.

Examination of the stomach of these animals has shown that, as a rule, they live on vegetable food. Still, there were found among the contents of the stomach, besides remains of small birds and lizards (which we mentioned above), eggshells and small animals of various description.

The iguanas are vicious, wily, but show staunch resistance when attacked. In defense they use their pointed, back-curved teeth, and slash with their tails, blows from which are rendered dangerous by the sharp comb.

The male iguana choses a partner once, and does not quit her after. He will protect her against any other animal, and fiercely assert his privilege in having secured her favor.

The females lay their eggs on sand banks, carefully bury them in the sand, and pay no further attention to them. The heat of the sun, in time, calls the young iguanas from the soft-shelled eggs.

THE IGUANA IN THE ZOO AT LEIPZIG.

To hunt these lizards a gun is useless as a rule, for they can stand a heavy charge of shot, and once warned are soon safe, either in water or dense foliage. A more certain means of laying them low is an Indian arrow, which is often deadly. Dogs also are trained to bring to bay this queer prey. Animals secured are brought to market, where they are sold at a good price, to be consumed on the boards of wealthy people.

In captivity iguanas at first prove vicious, and snap at their keepers. They must be kept fairly warm, and the temperature around them must be constant, else the climate soon tells upon, and their life is ended by an untimely death.

To get them accustomed to the feeding, it is usual to worry them till they open their mouths, then the food is brought under their teeth, and, once bitten, is soon devoured. In time the persuasive power of hunger proves stronger than the stupefaction caused by the unaccustomed surroundings, and no further trouble is given in that respect.

THE REPRODUCTION OF THE EEL.

By HENRY DE VARIGNY in La Nature.

ONE of the problems that has occupied the attention of naturalists from the time of Aristotle up to the present is the method of reproduction of the eel. It is not because there has been any reason for the belief that this fish multiplies by processes different from those of other living beings, but because the conditions under which the fertilization of the egg is accomplished and where it is hatched have not been known, and because, too, it has never been possible to obtain the fry of this fish. The problem has now been definitely solved by the researches of Prof. G. B. Grassi, of Rome, and of his pupil Signore Calandruccio. The results may be summed up as follows: The fact that eels introduced by man into ponds and lakes that have no communication with rivers and the sea do not reproduce, and that no young are ever observed therein, has led to the idea that reproduction does not take place in fresh water, and the admission has had to be gradually made that the eel proceeds to the operation of multiplication in salt water. There would be here a migration similar to that made by the salmon and shad, but in inverse order, the latter, inhabitants of salt water, ascending fresh water streams to spawn, and the former, an inhabitant of fresh water, going out to sea to reproduce its kind. This view, à priori, finds some confirmation, moreover, in the fact that the only young eels that are met in rivers are always making the ascent thereof. They ascend, but do not descend streams, and they seem to come from the sea.

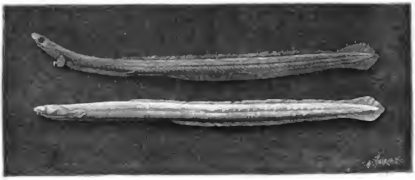


FIG. 1.—YOUNG EELS.

The eel therefore appears to reproduce itself in salt water; but where? And how is it that young eels are never found anywhere upon the coasts?

An interesting fact pointed out by Prof. Yves Delage, of the Sorbonne, some eleven years ago, ought to have put investigators upon the track. This fact was that a certain fish captured in the vicinity of Roscoff, and kept in captivity, changed into a conger, or sea eel. This fish belonged to a well-known group, that of the Leptocephala. This group has been a puzzling one, since the fishes that compose it seem to be incomplete, and they have a larval appearance. Their very small head (whence their name), the absence of scales, the slight development of the osseous skeleton, the absence of red corpuscles in the blood, and the general feebleness of their locomotion, all seem to indicate that these fishes, which are divided into several species by systematic zoologists, are young and not adults. In 1861 it was thought that they might be the larvæ of Cepola. In 1864 an American naturalist placed them in the family of eels, but Günther, in 1870, contended against these views in taking as a basis the fact that the Leptocephala are of larger dimensions than the young eels that ascend streams, and he regarded them as monstrous larvæ.

The transformation observed by Yves Delage, however, clearly showed where the truth was to be found, and Messrs. Grassi and Calandruccio resolutely entered the path opened by the French naturalist. Their success has been complete, and they must be congratulated upon it. Through them we now know that the fishes of the family Murenidæ first pass through a larval stage, and that the Leptocephala are nothing but the larvæ of Murenidæ. The Leptocephala therefore disappear, both as regards genera and species. They have no longer any zoological civil state and no longer form a systematic group, any more than do the tadpoles of the Batrachians or the caterpillars of the Lepidoptera; and the fact observed with regard to the common conger eel has likewise been observed with regard to several Murenidæ, and particularly the common eel.

The eel which interests us more particularly goes out to sea to reproduce its species. It does not, however, proceed everywhere to the work of reproduction, but makes a selection from among the innumerable sites that the sea offers it, and invariably takes refuge in the depths. It requires water having a depth of at least 1,000 feet. Is this a matter of taste merely, or is it because the eggs develop properly only under great pressures? This point is not yet elucidated. Among the localities where the conditions are found favorable in proximity to the coast may be mentioned the strait of Messina. Eels evidently visit this locality in large numbers, since the strong currents here often bring eggs and Leptocephala to the surface. In 1895 Prof. Grassi found the latter here by thousands; and when the currents are gentle, an almost certain method of procuring them consists in opening the easily captured Orthagoriscus mola. This fish, which inhabits the deep sea, always contains a few larvæ of Murenidæ in its digestive tube. These larvæ are met with from February to September and have long been known. They have been called by the name of Leptocephalus brevirostris, and it is they that are the young—the larval form—of the common eel, Anguilla vulgaris.

The accompanying figures, which we owe to the kindness of Prof. Grassi, represent the leptocephalus under consideration. It is from 2⅜ to 2¾ inches in length; and the extreme height of its body, which is very thin, forms a striking contrast with the somewhat cylindrical shape of the young eel. There is no doubt, however, of the connection between the leptocephalus and the eel. Prof. Grassi has directly observed the transformation of the leptocephalus in an aquarium, and, although the young eel is always shorter than the leptocephalus whence it proceeds, that is due to the fact that the latter, during its transformation, does not take any food and necessarily diminishes. While from the view point of external form the leptocephalus differs very greatly from the eel, there is, on the contrary, a complete concordance in the internal anatomy. The myomeras, the vertebral arches and the spinal ganglions are of the same number in each, and the rays of the pectoral fin of the leptocephalus are of the same number as those of the corresponding fin of the eel. We cannot enter here into the technical details given by Prof. Grassi, notwithstanding their interest; but it is well to remark that such interest is rather of a general order. While it is well to know what modifications occur or do not occur in the leptocephalus, it is not necessary to be acquainted with them in order to ascertain whether such transformation really takes place, since, through Prof. Grassi's direct observation, we know that the change occurs, and that the leptocephalus becomes a young eel.

In order briefly to recapitulate the history of the reproduction of the eel, we shall say, then, that the latter descends the rivers from October to January (in Italy at least) and that it reaches the deep sea, where (according to specimens occasionally thrown up by the currents) it undergoes evident modifications. Its eyes acquire dimensions that they never possess in fresh water, and it reaches sexual maturity, a thing that never occurs in rivers, nor in captivity, where we nevertheless find eels of 8 to 12 inches in which the sexual products do not succeed in developing. Reproduction takes place in deep water after the eel has lived therein for some time (a few months), and the pressure and

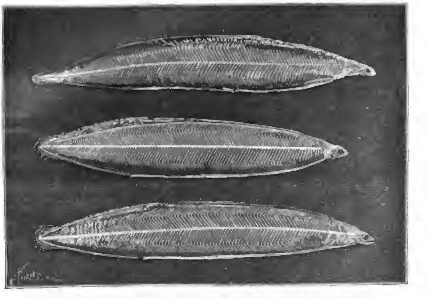


FIG. 2.—LARVA OF THE EEL (LEPTOCEPHALUS BREVIROSTRIS), STILL RELATIVELY YOUNG.

chemical constitution of the medium (and perhaps also other factors that escape us) evidently play a great part in the development of the sexual aptitudes. Eggs are found from the month of August to January, and the Leptocephali show themselves from February to September.

The duration of leptocephalic life is unknown. It is known, however, that a month is sufficient for the transformation into a young eel. It is Prof. Grassi's opinion that the young eel, that which ascends the rivers in spring, is already a year old; but of this year how many months belong to the larval state? This is a point to be cleared up.

And what becomes of the eel that has reproduced its kind? The general opinion is that it dies; that it does not return to fresh water, but ends its existence in the sea shortly after spawning. Such is the opinion given by Cunningham in his excellent "Natural History of the Marketable Marine Fishes of the British Islands."

This is very likely, moreover, since in fresh water we never find eels having the appearance of those that have lived in the sea, and most certainly if the latter returned to the rivers they would, for a time at least, preserve the peculiar character of the eyes that they had acquired in salt water.

Prof. Grassi has therefore very completely solved the problem of the eel; but we must say that he has not stopped here, for he has also studied the problem of other Murenidæ (Congromuraena mystax and C. Balearica, Ophichthys, Nettastoma, Saurenchelys, etc.), and, through a comparison of the larvæ and adults, has been able to show that all of the Murenidæ studied (save two, Chlopsis bicolor and Myrus vulgaris) first pass through a leptocephalic larval stage.

The details of these researches will be found in a memoir that he is publishing, but it has appeared to us useless to await this publication in order to make known the valuable work done by the Roman zoologist and his magistral elucidation of a problem that has defied so many naturalists.

In connection with the subject of the reproduction of eels, it may be of interest to note that the belief once universally entertained that eels present no distinction of sex seems to have been shared by the Massachusetts and Narragansett Indians, who, respectively, called the common fresh and salt water eels (Anguilla Bostoniensis) Nequttikaug and N'quittecounaug, dialectic variations of the same word, meaning "they go singly," or "one by one."

The Narragansetts, however, observed that there was at least one kind of an eel that apparently mated, and named the fishes of this species Neeshauog, meaning "they go in pairs." This name has been perpetuated, locally, in Massachusetts, in the form Neshaw, as the popular appellation for an eel that is sometimes taken in the salt ponds of Martha's Vineyard, and that Dr. Storer (Report on the Fishes of Massachusetts) supposes to be the silver eel (Murena argentea).

The fishes so designated by the Indians may have been sea lampreys (Petromyzon Americanus), the sexes of which usually ascend rivers in pairs, aid each other in piling up heaps of stones among which to spawn, and frequently exhibit evidences of mutual attachment.

UTAH UINTAITE DEPOSITS.

THERE has been published in the New York Tribune part of the seventeenth annual report of the United States Geological Survey, giving an account of "The Uintaite (Gilsonite) Deposits of Utah," and prepared by George Homans Eldridge. The name uintaite was given by Prof. W. P. Blake in 1885 to a variety of asphalt found in the vicinity of the Uinta Mountains in Utah. The name gilsonite, of a later derivation, was adopted because the substance was brought into prominence as an article of utility through the efforts of S. H. Gilson, of Salt Lake City. The trade knows it better by the latter name.

According to Mr. Eldridge, uintaite is employed chiefly in the manufacture of black, low grade brush and dipping varnishes, such as are used on the various kinds of iron work and as baking japans. It is employed by one company for mixing with an asphaltic limestone in the manufacture of paving material. Other uses, according to E. W. Parker, in "Mineral Resources of the United States" for 1893, are: preventing electrolytic action on iron plates of ships' bottoms, for coating barbed wire fencing, etc., for coating sea walls of brick or masonry, for covering paving brick, for acid proof lining for chemical tanks, for roofing pitch, for insulating electric wires, for smokestack paint, for lubricants for heavy machinery, for preserving iron pipes from corrosion and acids, for coating poles, posts and ties; for torpedo proof pile coating, for covering wood block paving, as a substitute for rubber in the manufacture of cotton garden hose, and as a binder pitch for culm in making briquette and eggette coal. Mr. Eldridge is inclined to believe,

however, that the uses of gilsonite as thus enumerated by Mr. Parker are in most instances still in the experimental stage.

In his paper, Mr. Eldridge treats of the classification of hydrocarbons and allied substances, chemical relations between hydrocarbons, resemblances and differences between the asphaltites, analysis of uintaite, geology of the Uinta Basin, and its topographical features, distribution of uintaite and allied hydrocarbons in the Utah fields, of the various uintaite veins, estimated tonnage of the uintaite fields of Utah, the exploitation of the veins, and commercial considerations.

The veins are known as the Duchesne, Culmer, Seabolt, Bonanza, Cowboy and Black Dragon. The most important locality of uintaite or gilsonite is the region immediately north and south of the White River, near the eastern edge of the Uncompahgre Reservation. The veins are here known as the Little Bonanza, Big Bonanza and Cowboy; they have not yet been exploited. The Duchesne vein, which lies near to and is named after Fort Duchesne, has been worked for several years, and is opened to a depth of 105 feet. The St. Louis Gilson Asphaltum Company controls the greater part of this vein, and has shipped a comparatively large amount of gilsonite in the five or six years it has been operating.

The Culmer and Seabolt veins cross the western edge of the Uncompahgre Reservation in the vicinity of the fortieth parallel. Only the Culmer is workable of these two, and this at a great disadvantage. The Black Dragon vein is situated in the region of Upper Evacuation Creek, and is one of great promise. The total tonnage contents of all these uintaite veins is estimated at 28,744,582. Mr. Eldridge says: "Mining for uintaite will be conducted after the ordinary methods, by means of shafts and tunnels. With the establishment of hoists and conveying machinery, of especial necessity will be the installation of a ventilating plant, for the dust derived from the gilsonite in mining is exceedingly annoying, penetrating both skin and lungs, and there remaining, except under the action of a solvent, impossible, of course, in the latter case. This peculiarity of the mineral is due to its insolubility in water, and to its softening under the temperature of the body. From the skin of the miner gilsonite dust is commonly removed by the application of kerosene oil. Besides the harmful results in breathing it, the dust has proved a dangerous element in mining, being highly explosive when its mixture with atmospheric air acquires a certain ratio, and it is then disturbed by the accidental fall of a lighted candle through it. Safety lamps can be used only with difficulty, on account of the heat melting the substance and forming a film over glass or gauze. Thus far ventilation has not been attempted, the men using aspirators, sponges, or other methods, the dust of the mine being laid once a week by spraying the walls with water, which finds its way to a sump and is raised in buckets."

COMMERCIAL CONSIDERATIONS.

The region within which the uintaite (gilsonite) veins occur is deficient in transportation routes. From the north it is inaccessible except by very indirect roads. To the south it is separated from the valley of the Grand and Price Rivers by the rugged Roan or Book Plateau and its canyons, though the travel of to-day is in this direction, the product of the Culmer and Duchesne Mines being taken by wagon to Price, on the Rio Grande Western Railway. Up Strawberry Valley and across the Wasatch Range the route is somewhat more difficult than the last, and the distance to railroad is considerably greater. The mines in the edge of Colorado now ship their product by wagon over a circuitous and hilly road, via Meeker, to Rifle, on the Denver and Rio Grande Railroad, 125 miles. It is thought possible, however, by those familiar with the country, to find a feasible route 50 to 70 miles shorter than this directly southward along the State line. The Bonanza and Cowboy group of veins is a little more remote from Rifle than are the Colorado openings, though, perhaps, attended with no greater difficulties of transportation. By the way of Fort Duchesne to Price the route from these veins is about 180 miles. The vein of uintaite (gilsonite) on Upper Evacuation Creek is, perhaps, a little more inaccessible than any of the others, unless it should be proved possible to establish a route directly south across the Roan or Book Plateau, when it would become the nearest of all the deposits to railroad communication.

The cost of freighting the product of the Duchesne and Culmer mines to rail is now $12 to $15 per ton. Railway freight to Chicago is said to be about $9 per ton. The total cost of mining and placing the material in Chicago or St. Louis is therefore not far from $25 per ton. Office and management expenses may increase this to $30. The present price per ton in Chicago and St. Louis for the best grade is $40 to $50, leaving a net profit of $10 to $20. The factors in a reduction of the price to the trade will be railroad transportation direct from the Uinta Basin, which seems probable at a future day, and competition, which will arise should any equable distribution of mining claims be made among the numerous companies that will doubtless be inclined to work these great deposits.

SOME ADVANTAGES OF GILSONITE.

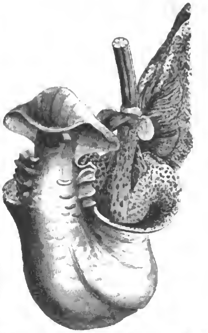
By some manufacturers the use of gilsonite in preference to other asphalts is considered advantageous from the standpoint of economy, as it is said to require less linseed oil to obtain equally satisfactory results, to have a greater capacity for the thinning medium with correspondingly less deterioration from its use, and to maintain an equal bulk of product with employment of a smaller percentage than of other asphalts.

The present cost of varnishes of the first quality made from gilsonite is about $1.25 per gallon, and somewhat lower for lower grades. From the evidence gathered by Mr. Eldridge, the opening of the gilsonite veins and competition among mining companies would tend to lower the price of the raw material to manufacturers, but many of the latter do not believe an increased supply of this would materially lower the price of the varnish, as competition has already brought this to a limit. There would result, however, an improvement in quality among those who are now inclined to adulterate with resin, and the foreign asphalts used for the same purpose would be driven almost entirely from the markets of the United States. The quantity of gilsonite used by varnish manufacturers would also doubtless be considerably increased, but the total consumption for this purpose would always be comparatively small, for among even the larger concerns a carload often lasts six months.

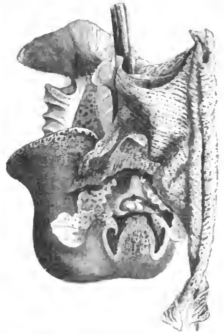
In the manufacture of paving cement, gilsonite of the second grade is melted with petroleum residue in a tank similar to that used for its liquefaction with linseed oil for use in varnish making. To the heated mixture is added ground asphaltic limestone carrying, perhaps, an average of 18 to 20 per cent. asphalt. After thorough mixing and heating, the material is drawn from the tank into barrels and stored ready for shipment. For paving it is remelted, the requisite amount of sand is added, and the mixture is then spread like the ordinary asphaltic paving material in such wide use in the larger cities.

THE CORYANTHES.

The members of this extraordinary section of the Stanhopea tribe, which are found rather widely distributed in tropical America, have been known to science for upward of three-quarters of a century. Although the plants have remained uncommon, the limited number of them which have flowered in gardens have caused more wonder and admiration by reason of the extraordinary structure and general dissimilarity to other flowers than have any of the showier and more popular species and genera. Every portion of the floral structure in Coryanthes affords proof of the correctness of the theory that orchid fertilization is brought about by insect agency, and what was conjectured from a study of the plants under cultivation has been fully substantiated by such careful observers as Dr. Crüger, formerly director of the botanic gardens, Trinidad; Mr. J. Rodway, F.L.S., and others, whose investigations were published in former issues of this journal.



CORYANTHES FIELDINGI—FRONT VIEW OF FLOWER.



CORYANTHES FIELDINGI—BACK VIEW OF FLOWER.

The Coryanthes are strictly epiphytal, and it was noted by importers that the specimens obtained by collectors were mere tufts of pseudo-bulbs proceeding from long oval masses of roots, and with scarcely a particle of moss or other substance or growth about them. These suspended masses were, according to the collectors, the homes of innumerable ants, and it was even asserted that the presence of the ants was essential to the well-being of the Coryanthes. This, however, as Mr. Rodway explained, is only another of Nature's wise provisions—the massed root growth of the plant supplies a congenial home for the ants, who in return attack the numerous other insects which would injure the plants, and thus in exchange for lodgings give protection.

Our illustrations of Coryanthes Fieldingi (Figs. 1 and 2), one of the oldest but still one of the most rare species, will indicate the size that the flowers of most of the Coryanthes attain. The structure of the flower is exceedingly strange, and not the least remarkable feature about it is the contrast between the membranous sepals and petals and the thick fleshy labellum, the former soon curling back into comparative insignificance, leaving the large and complicated lip as the chief attraction. As soon as the flower expands a strong and penetrating odor is emitted, and, to quote Dr. Crüger's words, "large humble bees, noisy and quarrelsome, are attracted at first by the odor; but this probably only gives notice to the insects. The substance they really come for is the interior lining of the labellum, which they gnaw off with great industry. They may be seen in large numbers fighting with each other for a place on the hypochile. Partly by these contests, partly perhaps intoxicated by the substance they are consuming, they tumble down into the bucket (epichile), which is half filled with the fluid secreted by the horn-like organs at the base of the column. They then crawl along the anterior inner side of the bucket, where there is a passage for them. If one is early on the lookout—for these Hymenoptera are early risers—one can see on every flower how fecundation is performed. The humble bee, in forcing its way out of its involuntary bath, has to exert itself considerably, as the mouth of the epichile and the face of the column fit together exactly, and are very stiff and elastic. The first bee that is immersed will have the gland of the pollen masses glued to its back. The insect then generally gets through the passage, and comes out with this peculiar appendage, to return nearly immediately to its feast, when it is generally precipitated a second time into the bucket, passing out through the aperture, and so inserting the pollen into the stigma while it forces its way out, and thereby impregnating either the same or another flower. I have often seen this, and sometimes there are so many of these humble bees assembled that there is a continual procession of them through the passage specified."

The above remarks related to Coryanthes macrantha, but they apply equally to other species. The congregating of the insects takes place on the cap above the ribbed mesochile, and the fall of the insect into the bucket, and its passage out, during which the act of fertilization takes place, is shown by the position of arrows.

The genus was founded by Sir W. J. Hooker in 1831 on C. maculata, joining with it C. speciosa and C. macrantha, which had previously been known as Gongora, and at different periods some ten or a dozen other species have been added. The prevailing colors of most of them is yellowish, with crimson and purple markings; though, as in the case of the C. maculata vitrina, imported by Messrs. F. Sander & Company, which is wholly greenish-yellow, varieties have appeared in which the colored marking is suppressed.

A plant of C. macrantha flowered recently with J. H. Kitson, Esq., Elmet Hall, Leeds (gr., Mr. T. Bonsall). A flowering plant of C. elegantium was figured under the name of C. macrantha in Gardeners' Chronicle, May 6, 1882, pp. 583 and 597.

Of comparatively recent introductions, five remarkably beautiful species may be specified, viz., C. macrocorys, distinguished by its slender, ungrooved mesochile and narrow and long hood; C. leucocorys, with rich purplish crimson bucket and pure white hood; C. Bungerothii, a rich yellow lipped species, spotted inside the lip with bright crimson, and in which the hood is prolonged over the neck-like mesochile, like a cape; C. Wolfii and C. Mastersiana, both of which are described by Consul F. C. Lehmann as of a new section of Coryanthes, with stout, ascending inflorescence, in the Gardeners' Chronicle, October 24, 1891, p. 483. The former has flowered in the Royal Botanic Gardens, Glasnevin, Dublin, and proved a very fine species.

Coryanthes, being epiphytal plants, require to be grown under cultivation in baskets, and with no great bulk of material, such as peat or sphagnum moss, around them. During growth an unlimited supply of rain water should be afforded, and the plants should be placed in a warm, moist, but airy house. After flowering is past, the condition of the Mexican house is best suited to their needs, but at no period should they be exposed to cool treatment. At the same time there is every reason to believe that the scarcity of the plants in gardens is mainly due to their being kept continually in the same excessively warm and too often ill ventilated house. It should be borne in mind that, whether growing in hot or cool houses, all orchids require ventilation.—J. O'Brien.

CORYANTHES LEUCOCORYS.

This species well shows the peculiar structure of the genus. A plant is now in flower in the botanic garden, Edinburgh, carrying one flower upon the pendulous

scape, which springs from the base of the furrowed pseudo bulbs. They are short lived; the sepals soon collapse, and, indeed, the whole flower lasts but three or four days. The principal attraction in the flower is, perhaps, the immense helmet-like structure into which the secretion drops—this being of a pale coral pink, and the ivory hood white. The plant has been grown in an unshaded part of a pit devoted to Nepenthes, and in this position it is well suited. A figure of this species is to be seen in Lindenia, t. 298; its habitat is Peru.—R. L. H., The Gardeners' Chronicle.

ARE MEN OF GENIUS DEGENERATES?

The theory of Lombroso, that genius is a form of degeneration, is opposed in the Revue des Deux Mondes (Paris, June) by M. G. Valbert. The Literary Digest translates as follows: After telling us that the Italian scientist has "passed his life in searching for and discovering cruel truths," the critic goes on as follows:

"The last of his [Lombroso's] discoveries is perhaps the most alarming, and he speaks of it with relish. It is with true enjoyment that he endeavors to persuade us that if alcoholics, criminals, cretins, and deaf mutes are degenerates, the great men are their cousins german, that genius is a sort of degenerative psychosis, belonging to the family of the epilepsies. . . .

"Lombroso believes that, after all, his theory has its consoling side; there comes to its aid the system of compensations, which has decreed that every advantage that is acquired shall have its drawback and that every gain shall be accompanied by a loss. 'The reptiles,' says Lombroso, 'have more functions than we, the monkeys have a greater number of muscles and an entire organ—the tail—that we lack. Only by losing these advantages have we gained our intellectual superiority.' The man who succeeds in convincing himself that his mind would fall suddenly to a lower scale if he had a tail, quickly consoles himself for not having one, and when we show that genius is a psychosis, we reconcile to their lot all minds that are mediocre or less than mediocre. They will even congratulate themselves that they have no kind of talent, for, according to Lombroso, 'the man of talent, even of genius, presents slight but real anomalies, which give occasion for injurious pathologic reactions whose traces are found in the tendency of his children to degenerate.' . . .

"But it is not sufficient to affirm that the theory of the psychosis of genius is a consoling truth; it is necessary to demonstrate that it is true, and people who are difficult to please will think perhaps that, when it comes to proof, Lombroso is satisfied with very little. This medical alienist, with his experiments and his skill, is a laborious compiler of anecdotes, which furnish him his strongest arguments. Some are curious, others are suspicious; most are less conclusive than he thinks."

After quoting a number of typical anecdotes and giving a brief sketch of Lombroso's ideas, most of which are already familiar to our readers, M. Valbert resumes his criticism as follows:

"The morose critics of whom I have spoken will perhaps complain that there is a good deal too much that is arbitrary in Lombroso's reasoning. He begins by asserting that the normal man is he who uses his mind only to gain his daily bread; it follows that men of superior intelligence are encroaching in some degree on common rights, that genius is a perversion and anomaly, and every anomaly is a case of disease. It is certain that men of genius do not abound, and if we are speaking only of great statesmen, Nature thinks she has done well if she produces three or four in a century. But M. Lombroso has a short memory; he forgets his first principles till they turn against him and confute his paradoxes. He declares that there are no exceptions in the world, that by virtue of what he calls the 'serial law' of his beloved statistics no phenomenon is produced that is not the expression of a numerous series of analogous facts, less distinct and less apparent. We may conclude from this that genius also is but the last term of a series. Numbers of men who have it not yet possess in a rudimentary state some of the qualities that it unites in all their glory—we may call these 'genial' men, and they have this advantage, they are very easily studied; they are petty suns that we may look at directly, without being dazzled; they do not oblige us to shade our eyes.

"There are 'genial' men in all ranks of society, in all classes, in all professions, in the country as in the city, and often amid the poor and humble. . . .

"But let us talk now only of the real genius . . . whether he paints or builds, whether he is sculptor or poet, whether he composes symphonies, epics, or dramas, whether he guides the destinies of a great people or leads armies in the field; we admire, equally with the extent of his thought and the grandeur of his conceptions, the justice of his view, the close connection of all parts of his work, the harmonious complexity of his designs and the simplicity and wisdom of his processes, the deep sagacity which, loving the real and the possible, sacrifices to them all chimeras, the rhythm of a will always regulated and always even, the obedience of a powerful imagination that consents to let itself be ruled by a sovereign and impassible reason.

"'These are degenerates, I tell you!' cries M. Lombroso from Turin, 'and you may be certain that many of them have protruding ears, an asymmetric visual field, and the handwriting of an epileptic or a lunatic!' We must not suppose that he is making fun and that he is putting our credulity to the test. This would be unfair to him. I believe in his seriousness as much as I doubt the infallibility of his methods. Has he his hours of doubt? Do disquiet, remorse, ever attack him? . . . Who knows? In his chapter on 'mattoids' he tells of a learned professor whose taste ran to enormities and who maintained that sea water owed its medicinal virtues to the expiration of fishes. 'And nevertheless his works,' he adds, 'contain very fine things and have reached a second edition; none of his colleagues ever suspected him of insanity. In what class shall we place him? Certainly in a rank midway between the insane person, the man of genius and the graphomaniac; with this last he has in common sterility of object, and the calm and steadfast investigation of paradoxes.' M. Lombroso is imprudent; does he not fear that some of his readers will suspect him of having doubled on himself and of applying the rod to his own back?"—Translated for the Literary Digest.

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STACKS IN READING ROOM.

THE NEW BUILDING.

NEW MASSACHUSETTS STATE LIBRARY BUILDING, AT BOSTON, MASS.

THE NEW MASSACHUSETTS STATE LIBRARY BUILDING, AT BOSTON, MASS.

WE present in this issue, on first three pages, engravings illustrating the new extension to the Massachusetts State Capitol at Boston, Mass. The corner stone of the old Capitol building, a view of which can be seen at the left of the picture, was laid on July 4, 1795. This building, usually spoken of as the "Bulfinch building," derives its name from the fact that Bulfinch, the first and one of the greatest American architects, designed it, and it has always been considered his masterpiece. The facilities of this building having been inadequate for many years, it was decided that the sadly needed room for the various departments of the State government be enlarged, and in 1889 the construction of the extension was authorized, and land was taken for the purpose in the rear of the Capitol, on the north slope of Beacon Hill. The corner stone of this building was laid with appropriate exercises by Gov. Ames, on December 21, 1890. The design was intended to harmonize with the Bulfinch front, and this idea is carried out in detail; but when you take into consideration that the new structure is more than twice the size of the Bulfinch building, you will readily see that it greatly dwarfs the latter, and that the effect sought has not been materialized. When the commissioners in charge of the construction in 1894 realized this defect, they very rapidly urged the demolition of the old Capitol building and to construct an entirely new one. This proposition naturally raised an indignant and universal protest throughout the commonwealth, and when an attempt was made to pass a bill through the Legislature to demolish this old Capitol building, rich in its style of architecture, with its colonnaded front and gold crested dome, standing as it does with historical interest upon a site overlooking the famous Boston Common, and making a picture which is dear to the heart of every true Bostonian, it was rejected by the Legislature, and the patriotic sentiment of the commonwealth won a victory over that of vandalism; hence the preservation of the old State House. There is a strong feeling that the reconstruction of the old part, made necessary by new conditions, should proceed with the most thoughtful regard for the spirit of Bulfinch's historic design, while making such changes as are essential to protect it against any ill treatment or injurious effects. The new extension which we present, and more particularly use as an illustration, is constructed of yellow brick, with white marble trimmings, simulating the familiar yellow and white of the colonial style. The underpinning is built of rock faced stone, the first story of dressed stone, and the remainder of the structure of brick, while the whole is surmounted with a massive frieze and balustrade. The only necessary requisite in a building of this character is the necessary apartments and their respective dependencies, and in the present case the actual and most essential requirements have been secured, and while the architecture is of a classic order, it is of the simplest expression; and how very effective an expression it is, when you take in consideration that the building was designed in keeping with the old building, and the general scheme of style and color is carried out with consistency to the last detail. The absolute plainness of the basement, except the outlying porches, the treatment of which is still severe, gives value to the arcades above, which is still further enhanced by the absolute plainness of its inclosing wall. The highest merit of the detail is that all of it tends to promote a high expression, and is far more valuable in its place, owing to its proper adjustment, which has been studied with complete success with reference to its situation and material. The outcome of the study that has been devoted to this work in composition, modeling and ornament can safely be called a classic piece of architecture with Romanesque feeling. The interior of the extension is pleasant, cheerful, well ventilated, and convenient. It contains the various administrative and executive departments of the commonwealth, and includes two handsome halls, that of the House of Representatives and the State Library, besides various committee rooms. The Senate remains in its chamber in the old building. The new Hall of Representatives is a handsome and richly decorated room, considerably larger than the old hall. The amphitheater shape, with its domed ceiling, lends itself well to fine decorative effects. The treatment is in the Italian Renaissance. Some of the prominent features of the scheme are the names of fifty-three men, prominent in Massachusetts history, inscribed in the frieze, beginning with John Carver and ending with Phillips Brooks. The names of the counties in the stained glass skylight, and the symbols of statecraft, law, commerce, science, industry and art that occupy panels in the coving and elsewhere, are also good features. Five large panels on the wall are intended to be occupied by decorative pictures representing events of Massachusetts history. The next department of importance is the State Library room, of which we give illustrations. Owing to the modern architectural effort being toward permanency, a demand has necessarily risen for fireproof interior fixtures, and if perfect security is to be obtained, not only must an apartment be fireproof, but also all its fixtures and its furniture, its connecting doors, interior trim and protecting shutters. Up to a comparatively recent period, these could not be secured of non-inflammable material, except at a large cost and in an unattractive form. The question in regard to the safe custody of the public records has become a grave necessity, and while considerations looking toward their longevity are justly recognized as of such importance as in some cases to be prescribed by statute, the prime factor for their safety still remaining for absolutely safe quarters for their custody and protection. The commission of experts having had these ideas in consideration, they adopted a basis upon which such a means could be materialized, and it does so conform in every respect. As an example of perfection in metallic building for interiors, we present a few specimen illustrations of the interior of the new State Library, one of which is an interior view of the reading room, delivery counter, desks and stack work, of which a glimpse is shown through the opening at end of room, this metallic work being of the highest order. A more detailed view is given of the alcove cases, which are built up of steel plates, ornamented with solid bronze ornaments and mouldings, fitted with marble base, and the Fenton system of adjustable library shelving. The last view is taken from the gallery in the stack room, and presents what the Fenton Company claim as one of their most important products, a perfect system of metallic library stack work, embodying all the points of lightness, ventilation, strength and utility, which were called for in the specification of twenty-one requirements as the essentials in a perfect system of library stacks. This metallic work must come with peculiar interest to architects and the building trades who have in consideration works of this character. The metallic work in this building has cost $125,000, and it was designed and built by the Fenton Metallic Manufacturing Company, with general offices and works at Jamestown, N. Y., and a New York office at 621 Broadway. The Capitol has one of the finest heating and ventilating plants in the world, constructed according to plans under Prof. S. H. Woodbridge, of the Massachusetts Institute of Technology. Another feature of particular interest is the lighting with electricity, furnished by a large isolated plant. The library stack room is splendidly lighted by a system that is certainly unique. Each tier is lighted by turning a switch. In the usual system of lighting library stack rooms, the turning on of the current lights the lamps overhead, but in this State Library the wiring is done so that when the current is switched on the lamps underneath the glass floor are also lighted as well as those above. Thus the light shines up through the glass floor, rendering access to volumes on the lower range as easy as those in the middle. Those who have had occasion to use libraries which have been poorly lighted will appreciate this convenience. The buildings will have properly laid out parks surrounding same when completed, and which will add much value to the picture presented.

Our engravings were made direct from photographs of the buildings, taken specially for the SCIENTIFIC AMERICAN.

READING ROOM.

NEW MASSACHUSETTS STATE LIBRARY BUILDING, AT BOSTON, MASS.

EXPERT TESTIMONY.*

By WILLIAM P. MASON.

IT will be remembered that a would-be facetious barrister once remarked that prevaricators might be properly arranged in an ascending series, to wit: ordinary fibbers, liars, and experts; an arrangement which I fear meets with the approval of many members of the bench and bar to-day. The cause for such harsh classification is not so very far to seek. It is based upon ignorance on the part of the bar, and at times upon what is worse than ignorance on the side of the "expert." With the culpable acts of the pseudo scientist we cannot waste our time. That he merits prompt condemnation is axiomatic; but a word is wanted touching upon what may be termed the ignorance of the court.

"When I take my place upon the witness stand," said a prominent toxicologist once to me, "I can never predict in what shape I shall be upon leaving it," a feeling with which most of us can, I fancy, sympathize pretty keenly.

Is it that we fear exposure of the weak points in our professional armor? Do we dread to say in public, "I do not know"? Hardly that, I take it. We are now possessed of so very little of that which one day may be known that no true scientist hesitates for an instant to plead legitimate ignorance. What really troubles us upon cross examination is that the court does not speak our language, a language often quite difficult of direct translation; that it is but rarely schooled in the principles of our science; and that, in consequence, it frequently insists upon categorical answers to the most impossible kind of questions.

The hypothetical questions showered upon the expert witness are sometimes veritable curiosities, so peculiar are they in their monstrosity. Who among us but has felt that the layman, who has simply to testify to observed facts, has an easy time of it indeed, when compared with him from whom there is expected an opinion under oath?

All scientific men are willing and anxious to have their work scrutinized carefully by their peers; but to be exposed to the one-sided criticism frequently encountered at the bar is quite another matter; for it must be remembered that after the adverse counsel has opened up what appears to be a glaring inconsistency in the testimony, the redirect examination may utterly fail to repair the breach, because of a lack of familiarity with a technical subject on the part of the friendly attorney.

This leaves the witness in the unenviable position of

* Address before the American Association for the Advancement of Science, August, 1897.

disagreeing with the general drift of his own testimony, while it deprives him of suitable means of insisting upon its revision and correction.

According to the writer's view, there is but one way to escape such dilemma, and that is by direct and immediate appeal to the judge; urging that the oath taken called for a statement of the whole truth and not the misleading portion already elicited.

To illustrate how serious a matter the partial testimony of an expert witness may be, and to show also to what extent lawyers may go who look only to the winning of their causes, permit me to refer to an already reported poison case in which I was employed by the people. It may be roughly outlined as follows:

Much arsenic and a very little zinc were found in the stomach.

The body had not been embalmed, but cloths wrung out in an embalming fluid containing zinc and arsenic had been spread upon the face and chest.

Medical testimony showed that no fluid could have run down the throat. Knowing the relative proportions of zinc and arsenic in the embalming fluid, the quantity of arsenic found in the stomach was twelve times larger than it should have been to have balanced the zinc also there present, assuming them to have both come from the introduction of the said embalming fluid by cadaveric imbibition. Other circumstantial evidence was greatly against the prisoner.

At the time of my appearing for the people, on the occasion of the first trial of the case, my direct testimony brought out very strongly the fact that a fatal quantity of arsenic had been found in the stomach, but no opportunity was given me to testify to the presence of the zinc found there as well, although the fact of its existence in the body was known to the prosecution through my preliminary report. Through ignorance of the nature of such report on the part of the defense, no change was made in the character of becoming acquainted with his whole story. Do not such differences in legal opinion make it very desirable that the expert, at least in capital cases, should be the employe of the bench rather than of the bar, in order that whatever scientific investigations are made may be entirely open to public knowledge and criticism?

Although the expert should earnestly strive to have what he has to say presented in the best form, he must remember that to secure clearness, particularly before a jury, technicalities should be reduced to a minimum. To a degree they are unavoidable, but let them be as few as possible. Illustrations should be homely and apt; capable of easy grasp by the jury's minds, and if possible taken from scenes familiar to the jury in their daily lives.

It is an unfortunate fact that the expert must be prepared to encounter in the court room not only unfamiliarity with his specialty, but also deep rooted prejudices and popular notions hoary with age and not to be lightly removed from the mind by the words of a single witness. As President Jordan has well said, "There is no nonsense so unscientific that men called educated will not accept it as science;" and, let me add, they will calmly attempt to shove the burden of proof upon the scientific man who is opposed to their views. Sanitary experts, in particular, run up against all sorts of popular superstitions and are inveighed against as "professors" by those who consider themselves the "practical" workers of the time; and, let it be noted, the burden of proof is uniformly laid upon these "professors'" shoulders, while the most astounding and occult statements made by the "practical" men may be received without verification.

One source of trouble, which perhaps is peculiar to the water expert, lies in the impossibility of utilizing analytical results such as were made many years ago.

Those who are not chemists fail to grasp the fact that carries. When the expert reaches a position of such prominence that he can state a thing to be so because he says it, irrespective of whatever may be written on the subject to the contrary, his course then is greatly simplified; but long before he attains that altitude he will have put himself upon record in many cases, and happy for him if the record so made be such as cannot be quoted to his disadvantage.

"If I had only not written my first book," is the reflection of many a distinguished author; while one of the great masters of music, referring to an opera, said: "It is one of my early crimes."

Above all things, the expert "should provide things honest in the sight of all men."

It is well for him to be deeply interested in his case, to feel in a measure as if it were his own, but it is unwise in him to become so partisan as to let his feelings affect his good judgment, and it would be indeed criminal should he permit his interest in any way to contort the facts.

Before the case is brought to a final hearing, it may be apparent that experiments before the court are possible and they may be demanded by the counsel in charge of the case. If such experiments be striking, easy of execution, and not too long, by all means make them.

Practical illustrations, particularly such as involve some fundamental principle, have great weight with the court; but these illustrations must not be such as would turn the court room into a temporary laboratory and involve the loss of much time in vexatious waitings.

Such experiments as are determined upon should be thoroughly rehearsed beforehand, no matter how simple they may be; for, of all failures, the court room experiment which declines to "go off" is perhaps the most dismal.

This brings to mind a kindred topic upon which there should be a word of caution; laboratory experiments,

VIEW IN STACK ROOM.

NEW MASSACHUSETTS STATE LIBRARY BUILDING, AT BOSTON, MASS.

my testimony during the cross examination, and I was permitted to leave the witness stand with a portion of my story untold. No witnesses were called for the defense, and the case was given to the jury with the darkest of prospects for the prisoner.

For many reasons, unnecessary to recount here, I was distinctly of the opinion that murder had been committed, but I felt, nevertheless, that common justice demanded that the prisoner should have been entitled to whatever doubt could have been thrown upon the minds of the jury, no matter how far fetched the foundations for such doubt might have been.

The first trial resulted in a disagreement of the jury. I was pleased to learn, before the second hearing of the case began, that the defense was prepared to go into the question of the embalming fluid; for the responsibility of permitting only a part of what I knew to be drawn from me, to the entire exclusion of the remaining portion, was greater than I wished to assume. The nature of my report to the coroner having been established, and certain opinions relating thereto having been fully ventilated, the jury were possessed of "reasonable doubt" and acquitted the prisoner. What now were the duties of the expert upon the occasion of the first trial of this case and how should he have construed the meaning of his oath?

One eminent legal light, to whom the question was referred, held that the expert was distinctly the property of the side employing him, and that his duty was simply to answer truthfully the questions put to him, without attempting to enlighten the court upon facts known to him, but not brought out by the examination, no matter how vital such facts might be.

Another held that although the above course would be proper in a civil case, yet, in a matter involving life and death, the witness should insist upon the court that the examination of water may not be looked upon from the same point of view as the analysis of an iron ore. The statement that water analysis is but of recent birth, and that it is yet in its infancy, is hard for them to appreciate, holding, as they naturally do, that what was true twenty years ago must be true to-day, if science does not lie.

A pit into which many an expert witness falls is prepared for him by insidious questions leading him to venture an opinion upon matters outside of his specialty. It is a fatal error to attempt to know too much. Terse, clear answers, well within the narrow path leading to the point in question, are the only safe ones; and when the line of inquiry crosses into regions where the witness feels himself not truly an expert, his proper course is to refuse to testify outside of the boundaries of his legitimate province.

Unfortunately the expert is as often invited to take these collateral flights by the side employing him as by the opposition. Affidavits in submitted cases are commonly written by the lawyers and not by the expert, although they are, of course, based upon his reports. In the strength of his desire to win the case, the lawyer often prepares a much stronger affidavit than his witness is willing to swear to.

The writer has had no little difficulty just at this point, and has had plenty of occasion to observe the irritation displayed by counsel upon a refusal to indorse statements which have been "too much expanded."

Every expert witness, especially in his early cases, is sure to have adverse authorities quoted against him; therefore it behooves him to be so familiar with the literature of his subject as to be capable of pointing out that such and such a writer is not up to date, or that such and such a passage, if quoted in full, would not bear the adverse construction that its partial presentation which work to perfection, may utterly fail when expanded to commercial proportions, so that it is wise to bear in mind the danger of swearing too positively as to what will happen in large plants, when the opinion is based only upon what is observed to occur upon the smaller scale. Like conditions will, of course, produce like results, but it is marvelous how insidiously unlooked-for conditions will at times creep into one's calculations, and how hard it is even to recognize their presence.

When preparing his case for presentation, the expert often errs in not dwelling more largely upon certain points because he thinks them already old and well known. To him they may be old, but to the public they may be of the newest. Not only is the public unequally posted with the specialist, but what it once knew upon the subject may have been forgotten. It is well, therefore, to insert, in a special report, matters that would be properly omitted from a paper prepared for a professional audience.

Sanitary problems are of especial interest to the public, but the amount of ignorance, or rather false knowledge, displayed concerning them is surprising and often difficult to combat. The sanitarian is not unfrequently called upon suddenly to defend a position involving complex statistics; and, because the data cannot be forthwith produced, the inference is drawn that his points are really without facts to support them and that they are consequently not well taken.

Long before he gets into court, particularly if the time for preparation of the case be short, the expert may well "pray to be delivered from his friends." He may receive a peremptory order by telegraph to "determine the mineral qualities of this rock," when the telegram should have read: "Assay this ore for silver;" and later it may be a matter of surprise that a quanti-

tative knowledge of the copper present was not obtained while passing along the line for the determination of the silver; for it is not generally known that the complete analysis of anything is quite rare and correspondingly tedious and expensive.

Toxicologists who hear me may call to mind some case involving a search for the presence of an alkaloid, strychnia for example, during which search, the district attorney, in his eagerness for information, may have asked to know what the indications were as to the presence of the poison, at a time when the extraneous organic matter was not nearly removed. He may have wished no final report, but only the simple probabilities, whereon to base a possible arrest. Such requests are very common, and are akin to a demand for a proof of the pudding during the early baking, when we all know that such proof comes at a much later stage of the proceedings.

Finally, "When doctors disagree, who shall decide?" This question is often very vigorously settled by the jury, as was instanced in a recent celebrated murder trial in New York City. In that case what the experts had to say on either side was simply thrown overboard as a whole, and the finding was based upon the testimony of the remaining witnesses.

What can be said upon this question of the disagreement of expert witnesses? First, it must be noted, they are far from being the only class of people who fail to agree, and that, too, on very important subjects. Do my hearers think it would be a very difficult task to find a small army of men who would testify very variously and very positively upon questions of politics or religion? Would it be hard to find "good men and true" who would give under oath greatly differing opinions concerning the propriety of instituting free trade or establishing an inheritance tax? Experts are subject to the same errors of judgment as befall the rest of professional humanity, and, when their opinions clash, they are entitled to the same respect that we grant to the members of the bench when they hand down the decision of a divided court.

One fruitful opportunity for disagreement always arises when questions are brought into court touching upon matters newly discovered and apart from the well beaten path of common professional knowledge. Doubt is often left upon the minds of those seeking the light, even when the testimony is given by the specialist who originally developed the new point in question, for one cannot be expected to be thoroughly educated in that which he has himself but recently discovered.

Many of us have dreaded to see the "ptomaines," or putrefactive alkaloids, make their way into court with their mystifying influences upon judge and jury and their tendency to protect crime. Now that they are in, what is to be the end? Even with no "ptomaine theory" possible, the ptomaine form of argument is not unknown. The writer was once asked in an arsenic case whether he was willing to swear that at some future time an element would not be discovered giving the stated reactions now called arsenical. Such nonsense is of course instituted to impress the jury, and is suggested by similar questioning in the alkaloid cases.

A recent and somewhat amusing instance arose from an attempt to introduce the rather new conception of "degeneracy" into a murder trial. The defense sought to show that the prisoner was a "degenerate," and offered expert testimony as to the meaning of the term and as to the signs whereby such a condition was to be recognized; whereupon the prosecution called attention to the fact that the defendant's experts themselves exhibited every one of the signs in question.

Having said all that he was to say, and having stated it to the best advantage, should the expert depend upon the stenographer so recording it as to allow of its being used in future without correction? Decidedly not.

The average stenographer is unfamiliar with technical terms, especially such as are chemical, and the witness who fails to supervise the minutes may find out later that he was sworn to a most remarkable array of "facts." The writer once discovered that he had recommended, as a very efficient method of purifying a city water, the filtering of the entire supply "through a layer of black mud." Not to take your time further, let us summarize what has thus been briefly said:

The expert witness should be absolutely truthful, of course; that is assumed, but beyond that he should be clear and terse in his statements, homely and apt in his illustrations, incapable of being led beyond the field in which he is truly an expert, and as fearless of legitimate ignorance as he is fearful of illegitimate knowledge.

Mounting the witness stand with these principles as his guide, he may be assured of stepping down again at the close of his testimony with credit to himself and to the profession he has chosen.

PERPETUAL MOTION.—I.*

The search after "perpetual motion"—so called—though centuries of vain effort have brought only failure, still captivates those who believe in the possibility of such a machine, exacting time and money from its votaries. To the end that it may be seen how hopeless are all such efforts, and that inventive genius may be turned into more profitable channels, we have decided upon publishing the present series of articles.

It is not designed to make these papers a connected history of the numerous attempts which have been made at solving this problem. Our object will be principally to place before our readers some of the most plausible devices that have deceived people into waste of time and money, that others may shun these false paths; for it is noteworthy that not one of the devices which have been brought to our notice by modern inventors, in the course of our long and large practice as patent solicitors, has not had its prototype in some invention that preceded it. "There is nothing new under the sun," said Solomon the wise, and certainly so far as "perpetual motion" machines are concerned, Solomon was right.

Many people are not very clear in their ideas of what is meant by "perpetual motion," and the term itself is one of those unfortunate ones calculated to mislead those who do not use language critically.

The perpetual motion so long sought by inventors is not something that moves or will continue to move forever, or that will move till it wears out. A water wheel placed on a never failing stream is a perpetual motion, if this be the true meaning of the term. Neither is it a machine that, once set in motion by an external force, will retain its motion forever, or until it is stopped by the action of another external force, though even such a machine has never been constructed by human hands. A wheel armature suspended from a magnet having just power enough to keep it from falling, and placed in vacuo is probably the nearest approach to such a machine ever attained by mortals. The pendulum hung on knife edges in vacuo will retain its motion nearly as long. Theoretically, if we can eliminate from any moving body all resistances, it would never cease moving and would become literally a perpetual motion, though not the thing sought. The motions of the tides, the rotation of the earth, and the motions of the heavenly bodies, will continue for ages, but of these there is not one of which an astronomer would dare to predict that it will never cease.

So far as we can see, there is no single motion in nature that can be called perpetual, though change is perpetual, and motion somewhere, either of molecules or masses, must, according to the conclusions of modern science, always exist. Such can be the only conclusion drawn from the doctrine of the "conservation of force," of which the great Faraday said that it is the highest physical law of which the human mind can form any conception.

The perpetual motion of which visionaries have dreamed, and for which enthusiasts have labored, is a machine that will, under ordinary circumstances, start itself and increase its motion till it reaches a maximum, overcoming the resistances of air and friction, and possessing a surplus of motion to spare for the impulsion of other machines not self-moving. That there may be no mistake, in terms, let us adopt the name of "self-mover" for this supposed desideratum. It is not a new term, but is the only one that does not mislead thought in the consideration of the subject. Of the term "perpetual motion" Prof. Nichol, in his "Physical Sciences," says:

"If this famous appellation had simply meant perpetuity or indestructibility of force, it would have stood for an important and undeniable truth. No force is lost in the universe; we never discern the loss, but only the conversion of force, e. g., when a machine is brought to a stand through friction, all that has occurred is—the force applied to move the machine has, through the resistance we call friction, been converted into a mechanical equivalent of heat; and this heat, by communication and radiation, is in existence playing its equivalent mechanical part. But this is not the common or practical conception attached to the term perpetual motion. It has ever signified as follows: A machine whose characteristic is that the initial or primary force shall be restored or replaced by the very movement it produces. Now, setting aside the fact that, in every machine of earthly materials, part of the initial force must ever be converted into heat and dissipated through effect of friction, it is clear that, were such a machine consummated, the effect would be not motion, but equilibrium or rest. A machine is a mere medium of connection between power at one end and effect at the other; and were these two equal, the machine would simply stand still. The negation of the possibility of perpetual motion may therefore be accepted as an axiom in mechanical science. Mr. Grove has recently shown, in a most ingenious essay read before the Royal Institution of London, that important uses may be made of this axiom as an aid in scientific research. He has illustrated, by many important instances, that, considered as a test, it might enable us to discern in any experiment to what degree of approximation we have obtained, from any given natural force, the total quantity of power it is capable of affording; and that it might also serve, on the discovery of any new phenomenon, to show up to what point that phenomenon might be put in relation with phenomena formerly known."

From what we have said it will be inferred that we believe a self-moving machine to be an impossibility; but while we entertain this view, we do not forget that many able minds have held an opposite opinion, and that it has been even claimed that in two instances such machines have been actually constructed. These instances will receive notice in their proper place hereafter. We do not, then, "sit in the seat of the scornful," in regard to those who have attempted to reach the goal which has by its delusive promises led many an unfortunate inventor on to his ruin. Nor will we dogmatically assert that our opinions are infallible. All we say is, that we believe those opinions founded on sound scientific principles, and that whoever tries to produce a self-mover is wasting his time, money, and powers to no purpose.

John Wilkins, the Bishop of Chester, who died in 1672, and who, during his life, wrote upon the subject, classes the means employed to reach the desired object under these heads:

1. By Chymical Extractions.
2. By Magnetical Virtues.
3. By the Natural Affection of Gravity.

He says:

"The discovery of this hath been attempted by Chymistry. Paracelsus and his followers have bragged, that by their separations and extractions they can make a little world which shall have the same perpetual motions with this microcosm, with the representation of all meteors, thunder, snow, rain, the courses of the sea in its ebbs and flows, and the like. But these miraculous promises would require as great a faith to believe them, as a power to perform them; and tho' they often talk of such great matters,— . . . yet we can never see them confirmed by any real experiment; and then, besides, every particular author in that art hath such a distinct language of his own (all of them being so full of allegories and affected obscurities), that 'tis very hard for any one (unless he be thoroughly versed amongst them) to find out what they mean, much more to try it.

"One of these ways (as I find it set down) is this: Mix five ounces of ☿ with an equal weight of ♃; grind them together with ten ounces of sublimate; dissolve them in a cellar upon some marble for the space of four days, till they become like oil olive; distil this with fire of chaff, or driving fire, and it will sublime into a dry substance; and so, by repeating of these dissolvings and distillings, there will be at length produced divers small atoms, which, being put into a glass well luted, and kept dry, will have a perpetual motion.

"I cannot say anything from experience against this; but methinks it does not seem very probable, because things that are forced up to such a vigorousness and activity as these ingredients seem to be by their frequent sublimings and distillings, are not likely to be of any duration. The more anything is stretched beyond its usual nature, the less does it last; violence and perpetuity being no companions. And then, besides, suppose it true, yet such a motion could not well be applied to any use, which will needs take much from the delight of it."

This example is enough, we think, to satisfy our readers of the absurd character of the attempts to obtain a self-mover by "chymical extractions," and though chemistry has advanced to the front rank of sciences since that time, any attempt to get a perpetual motion through its aid would be even more absurd to-day than in Wilkins' time, since it is, in a great measure, through the aid of this science that molecular physics has advanced to the knowledge of the "conservation of force."

The second class of means, viz., by "magnetic virtues," is exemplified by a device of which we give herewith an engraving (Fig. 1).

Of this, and similar attempts, our author says:

"But amongst all these kinds of inventions, that is most likely, wherein a loadstone is so disposed that it shall draw unto it on a reclined plane a bullet of steel, which steel, as it ascends near to the loadstone, may be contrived to fall down through some hole in the plane, and so to return unto the place from whence at first it began to move; and, being there, the loadstone will again attract it upwards till coming to this hole, it will fall down again; and so the motion shall be perpetual, as may be more easily conceivable by this figure:

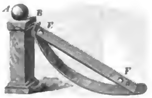


Fig. 1.

"Suppose the loadstone to be represented at A B, which, though it have not strength enough to attract the bullet, C, directly from the ground, yet may do it by the help of the plane, E F. Now, when the bullet is come to the top of this plane, its own gravity (which is supposed to exceed the strength of the loadstone) will make it fall into that hole at E; and the force it receives in this fall will carry it with such a violence unto the other end of this arch, that it will open the passage which is there made for it; and by its return will again shut it; so that the bullet (as at the first) is in the same place whence it was attracted, and, consequently, must move perpetually."

But however this invention may seem to be of such strong probability, yet there are sundry particulars which may prove it insufficient; for

"This bullet of steel must first be touched, and have its several poles, or else there can be little or no attraction of it. Suppose C in the steel to be answerable unto A in the stone, and to B; in the attraction, C D must always be directed answerable to A B, and so the motion will be more difficult; by reason there can be no rotation or turning round of the bullet, but it must slide up with the line, C D, answerable to the axis, A B.

"In its fall from E to G, which is motus elementaris, and proceeds from its gravity, there must needs be a rotation of it; and so 'tis odds but it happens wrong in the rise, the poles in the bullet being not in the same direction to those in the magnet; and if in this reflux it should so fall out, that D should be directed toward B, there should be rather a flight than an attraction, since those two ends do repel, and not draw one another.

"If the loadstone, A B, have so much strength, that it can attract the bullet in F, when it is not turned round, but does only slide upon the plane, whereas its own gravity would rowl it downwards; then it is evident the sphere of its activity and strength would be so increased when it approaches much nearer, that it would not need the assistance of the plane, but would draw it immediately to itself without that help; and so the bullet would not fall down through the hole, but ascend to the stone, and, consequently, cease its motion; for, if the loadstone be of force enough to draw the bullet on the plane, at the distance F B, then must the strength of it be sufficient to attract it immediately unto itself when it is so much nearer as E B. And if the gravity of the bullet be supposed so much to exceed the strength of the magnet, that it cannot draw it directly when it is so near, then will it not be able to attract the bullet up the plane, when it is so much farther off.

"So that none of all these magnetical experiments, which have been as yet discovered, are sufficient for the effecting of a perpetual motion, though these kind of qualities seem most conducible unto it; and perhaps, hereafter, it may be contrived from them."

From among many devices under the third class, we select the one shown in Fig. 2, whereby the desired motion is sought through the action of fluid weights:

"Where the figure, L M, at the bottom, does represent a wooden cylinder with helical cavities cut in it, which at A B is supposed to be covered over with tin plates, and three water wheels upon it, H I K; the lower cistern, which contains the water, being C D. Now, this cylinder being turned round, all the water which from the cistern ascends through it, will fall into the vessel at E, and from that vessel being conveyed upon the water wheel, H, shall consequently give a circular motion to the whole screw. Or, if this alone should be too weak for the turning of it, then the same water which falls from the wheel, H, being re-

* Reprinted from the Scientific American, 1870-71.

ceived into the other vessel, F, may from thence again descend on the wheel, I, by which means the force of it will be doubled. And if this be yet unsufficient, then may the water which falls on the second wheel, I, be received into the other vessel, G, and from thence again descend on the third wheel at K; and so for as many other wheels as the instrument is capable of. So that, besides the greater distance of these three streams from the center or axis by which they are made so much

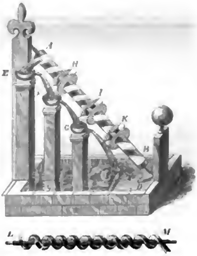


FIG. 2.

heavier, and besides that the fall of this outward water is forcible and violent, whereas the ascent of that within is natural—besides all this, there is thrice as much water to turn the screw as is carried up by it.

"But, on the other side, if all the water falling upon one wheel would be able to turn it round, then half of it would serve with two wheels, and the rest may be so disposed of in the fall as to serve unto some other useful delightful ends.

"When I first thought of this invention, I could scarce forbear, with Archimedes, to cry out eureka, eureka; it seeming so infallible a way for the effecting of a perpetual motion that nothing could be so much as probably objected against it; but, upon trial and experience, I find it altogether insufficient for any such purpose, and that for these two reasons:

"1. The water that ascends will not make any considerable stream in the fall.

"2. This stream, tho' multiplied, will not be of force enough to turn about the screw.

"1. The water ascends gently, and by intermissions; but it falls continually, and with force; each of the three vessels being supposed full at the first, that so the weight of the water in them might add the greater strength and swiftness to the streams that descend from them. Now, this swiftness of motion will cause so great a difference betwixt them that one of these little streams may spend more water in the fall than a stream six times bigger in the ascent, tho' we should suppose both of them to be continuate; how much more, then, when as the ascending water is vented by fits and intermissions, every circumvolution voiding so much as is contained in one helix; and, in this particular, one that is not versed in these kind of experiments may be easily deceived.

"But, secondly, tho' there were so great a disproportion, yet, notwithstanding, the force of these outward streams might well enough serve for the turning of the screw, if it were so that both its sides would equiponderate the water being in them (as Ubaldus hath affirmed). But now, upon farther examination, we shall find this assertion of his to be utterly against both reason and experience. And herein does consist the chief mistake of this contrivance; for the ascending side of the screw is made, by the water contained in it, so much heavier than the descending side, that these outward streams, thus applied, will not be of force enough to make them equiponderate, much less to move the whole."

In the library of the British Museum is an edition of "A very necessarie & profitable booke, concerning Nauigation, compiled in Latin by Joannes Taisnierus, a public professor in Rome, Ferraria, and other universities in Italie of the Mathematicalles, named a Treatise of Continuall Motions; translated into English by Richard Eden." It is a black letter quarto tract, printed by Richard Jugge, without date, consisting of eighty-two pages. The first part is "Of the Vertue of the Loadstone," and the second part is "Of continual motion by the said stone Magnes." It was reprinted in 1579. In his introductory remarks, he observes, in allusion to continual motion, that it is—

"The thing which to this day in manner from the beginning of the world, great philosophers with perpetual studie and great labour, have endeavoured to bring to effect, and desired end, hath nevertheless hitherto remayned eyther unknown or hydde, not without great damage & hyndrance of most expert mathematicians. . . .

"From the begynnyng of the worlde, in manner all naturall philosophers and mathematitians, with great expences and labour, have attempted to fynde out a continual motion or moovyng, yet unto this day have few or none atteyned to the true ende of their desyre. They have attempted to doo this with divers instrumentes & wheeles, & with quicksylver, not knowyng the vertue of this stone. Neyther can continual motion be founde by anye other meanes, than by the stone Magnes, in this manner. Make a holowe case of sylver, after the fashion of a concave glasse, outwardly laboured with curious art of gravyng, not onely for ornament, but also for lyghtnesse; the lyghter that it is, so much the more easyer shal it be mooved, neyther must it be so pearced through, that such as are ignorant of the hyd secrete, may easyly perceyve it. . . .

"It must have on the inner syde certayn little nayles & denticles or smal teeth of iron of one equal weyght, to be fastened on the border or margent, so that the one be no further distant from the other, then is the thycknesse of a beane or chick pease. The sayd wheele also must be in all partes of equall weyght, then fasten the exiltree in the myddest, upon the whiche the wheele may turne, the exiltree remaynyng utterly immoveable. To the whiche exiltree agayne shal be joyned a pynne of sylver, fastened to the same, & placed betweene the two cases in the hyghest parte, whereon place the stone Magnes. Beyng thus prepared let it be fyrste

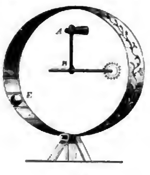


FIG. 3.

brought to a rounde fourme, then (as is sayd) let the poles be founde: then the poles untouched, the two contrarye sydes lying betweene the poles, must be fyled & pullyshed, & the stone brought in manner to the fourme of an egge, & somewhat narrower in those two sydes, lest the lower parte thereof shoulde occupie the inferior place, that it may touche the walles of the case lyke a little wheele. This done, place the stone upon the pynne, as a stone is fastened in a ryng, with such art, that the north pole may a little inclyne toward the denticles, to the ende that the vertue thereof woorke not directly his impression, but with a certayne inclination geve his influence upon the denticles of iron. Every denticle therefore shall come to the north pole, & when by force of the wheele it shal somewhat passe that pole, it shal come to the south part, whiche shal dryve it back agayne; whom then agayne the pole artike shall drawe as appeareth. And that the wheele may the sooner doo his office within the cases, inclose therein a litle calculus (that is a litle rounde stone or pellet of copper or sylver, of suche quantitie, that it may commodiously be receyved within any of the denticles; then when the wheeles shal be raysed up, the pellet or rounde weyght shal fal on the contrary parte. And whereas the motion of the wheele downwarde to the lowest part, is perpetuall, & the fal of the pellet, opposite or contrary, ever receyved within any two of the denticles, the motion shall be perpetuall, because the weyght of the wheele & pellet ever enclyneth to the centre of the earth & lowest place. Therefore when it shal permit the denticles to rest about the stone, then shal it well serve to the purpose. The myddle places within the denticles ought so artificially to be made belowe, that they may aptly receive the fallyng pellet or plommet, as the fygure above declareth. And briefly to have wrytten thus much of continual motion may suffice.

"Description of the Engraving, Fig 3.—A, the stone; B, the sylver pinne; E, calculus, a little rounde stone or small weyght."

Notwithstanding our author of the 15th century seems so satisfied with his invention, we find that two centuries later the world was still without the desired self-mover, for Jacob Leupold, in a work published at Leipsic in 1724, says:

"It still remains to find out this wonderful and undiscovered thing, which to the present time remains impossible both mathematically and mechanically, so far as we yet know. Great weight only increases friction, but there was a wheel or machine that did not weigh above forty pounds, and was nine feet diameter, which promised better results, yet failed like others, and so dissipated all hope of succeeding.

"Notwithstanding we hold that perpetual motion is not an impossibility, as has been shown to all the world by Councillor Orffyreus, and attested by the princely word of the Landgrave of Hesse Cassel, a prince himself well grounded in the science of mechanics, and who so minutely scrutinized and observed this wonderful motion, which was with him on trial during two months; all of which time he kept the machine in a sealed chamber.

"To all the seekers after perpetual motion the following remarks will be found most valuable:

"1. That they must endeavor to construct one of the simplest of machines; for the more material and workmanship, the less chance of durability. And if not found in such simple arrangement, it will be hid for ever.

"2. That it must be tried by experiment and not only on paper, for the friction and action can only be estimated by trial.

"3. That unless grounded in the fundamental principles of mechanics, no one should attempt the project, as he will only lose time and money. The thousands who fail of success yet learn something of mechanics, and that one pound cannot move more than one pound, but always arrives at an equilibrium."

In a work entitled "A History of the Manual Arts," we find the following:

"Archimedes, of Syracuse, the greatest mathematician and the rarest engineer that was in his time, invented a sphear and an artificial heaven, wherein he did represent the rotations and revolutions of the planets," and of which Claudian gives a poetic description—"that this machin did move of itself; it was an automaton, a self-moving device;" and further, "that these motions were driven and acted by certain spirits pent within;" also of another device of "a silver heaven sent by the Emperour Ferdinand for a present to Soliman the Grand Signior," with twelve men, and a book "that shewed the use of it, and how to order and keep it in perpetual motion." An account is next given of Cornelius van Drebble, a Dutchman, of Alcmar, engineer to King James in England:

"He presented the king with a rare instrument of perpetual motion, without the means of steel, springs, or weights; it was made in the form of a globe, in the hollow whereof were wheels of brass moving about, with two pointers on each side thereof, to proportion and show forth the times of dayes, moneths, and years, like a perpetual almanack."

The accompanying engraving, Fig. 4, is taken from a work by Robert Fludd, published in 1618.

It is a water wheel which is expected through a system of gearing to operate a chain pump, which pump should raise the water necessary to propel the wheel, and so on forever. It is probably unnecessary to inform our readers that this fallacious principle has been tried in various ways, and that there are occasionally yet to be found those so unskilled in mechanical science, and incapable of seeing the radical error of the device, as to waste their substance in a repetition of this time honored blunder. We have now in mind an instance in point, in which a man spent the accumulation of an industrious life in endeavoring through various makeshifts to get such a wheel to move, and who has brought poverty upon his declining years, through his absurd experiments. It was earnestly sought by his friends to convince him that nothing in falling could perform more work than that required to raise it to the point from which it is allowed to descend, but all such efforts proved vain, and our perpetual motion seeker would not desist till he had sunk his bottom dollar. "Perseverentia vincit omnia" was his reply to every argument and appeal, a motto which perhaps is true when applied to possibilities, and the failure of which in all the attempts to secure a self mover only strengthens the belief in the impossibility of the thing sought.

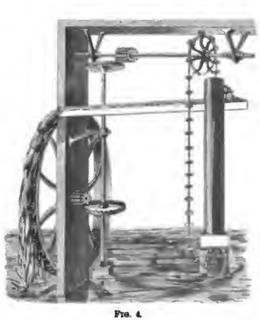


FIG. 4.

(To be continued.)

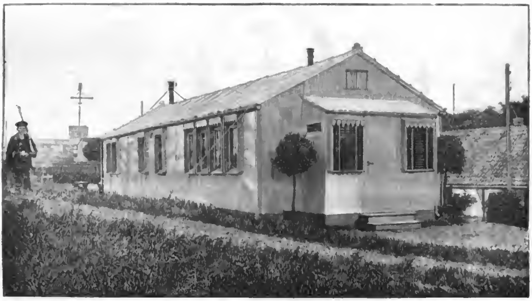
EMPEROR WILLIAM'S PAVILION ON HELIGOLAND.

FOR the time that the Emperor of Germany was to spend on Heligoland, at the occasion of the English Jubilee regatta, a pavilion was erected in the garden of the governor. It was constructed on the same pattern as the Döcker barracks, such as are supplied to the German, Austrian, Russian and other armies, the German navy and Red Cross societies. The usual dimensions for army use are 40×16 ft. The Emperor's barrack is some three feet longer. In its internal arrangements it differs from the others only by a slightly modified distribution of the rooms and by richer wall decorations. The whole, too, is finished in more elegant style. Besides a drawing room of 18 ft. 6 in.×16 ft. 3 in., the pavilion contains a bed room 16 ft. 3 in. square, and a bath room 16 ft. 3 in.×9 ft. 9 in., a servants' room 13 ft.×6 ft. 6 in., and a hall, 6 ft. 6 in.×3 ft. 3 in. In front of the drawing room there is an ante-chamber attached to the main part of the pavilion. Its dimensions are 9 ft. 9 in.×3 ft. 3 in. The floor is made up of 24 boxes, which serve to pack the walls, etc., for transport. When empty, they are hooked into one another by a peculiar system of connections, and they then form a strong, stable foundation for the barrack. On them the walls are erected, and they support the pavilion. All parts of the building are connected and held together by ingenious bolts.

Notwithstanding the strong wind of Heligoland, the pavilion was built up in eight hours. It stands on a small hill in the beautiful garden of the governor, with a charming view from the gable, over the sands.

The interior is simple, but elegant. The floors are covered, some with carpet, others with linoleum, and light hangings, in harmony with the furniture of the room, adorn the windows. A stove supplied by the firm Junkers and Ruh, of Karlsruhe, stands in the drawing room. The bath and stove were supplied by Joseph Junk, of Berlin, while the decorative painting was done by Lange, the hanging of the curtains by Kämpfer, both of Berlin.

For our illustration we are indebted to Illustrirte Zeitung.



EMPEROR WILLIAM'S PAVILION, HELIGOLAND.

THE PADDLE STEAMER WALTON BELLE.

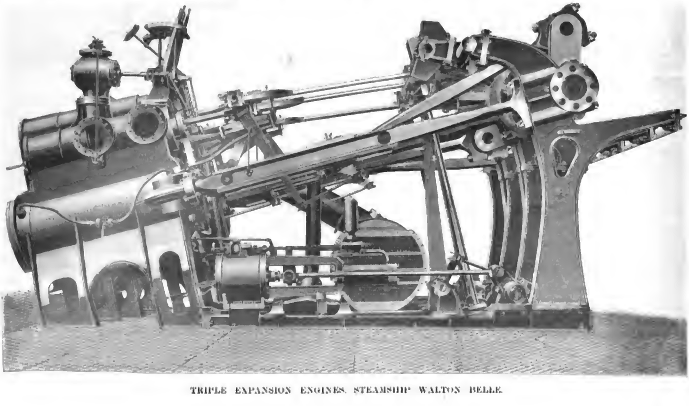
A VALUABLE addition to the well known pleasure fleet of the Belle Steamers Company, Limited, has just been contributed from the Dumbarton yard of Messrs. William Denny & Brothers, the builders of the four other steamers owned by the company. This vessel—the Walton Belle—having first run her official trial satisfactorily on the Firth of Clyde was recently taken upon an opening trip from Fresh Wharf to the Mouse Light and back. Messrs. Denny's first contribution to the fleet of the Belle Steamers Company was the Clacton Belle of 458 tons, built in 1890. Then followed the Woolwich Belle of 298 tons, in 1891; the London Belle of 738 tons, in 1893; the Southend Belle of 570 tons, in 1896; and now the Walton Belle of 470 tons.

Colonel John M. Denny, M.P., humorously remarked on the occasion of the recent trip to the Mouse and back: "This boat is not so big as the larger ones, but she is technically and scientifically the biggest success in paddle propulsion we have ever built." In view of Messrs. Denny's performances with their Belgian, Stranraer, and Arran paddle steamers, this is saying a very great deal indeed for the efficiency of the Walton Belle. This vessel measures 230 ft. long by 26 ft. broad, and 10½ ft. moulded depth, and has a promenade deck 104 ft. long. She is primarily intended for a new service between Clacton and Yarmouth just opened by her owners in connection with their trade from London Bridge.

The steamers of the Belle Company have done a great deal toward attracting Londoners from the railway to the sea as a way of taking a summer day excursion. Already the Thames enjoys almost as great facilities in this respect as the Clyde itself, which is the birthplace of the coast excursion paddle steamer. With five millions of possible customers so close at hand, there seems no reason why this enterprise should not only prove a boon to the population, but a source of profit to the companies which have developed it. It is gratifying to learn from Mr. Peter Denny that the owners of this fleet of vessels, which have navigated the Thames and the Essex coast for six summers continuously, carrying many thousands of passengers in that time, have never lost a single life.

This success is no doubt largely, and, indeed, principally, due to the thoroughness with which the owners and their staff have conducted their operations, both in the efficiency of the vessels they have acquired and in the care with which they have been navigated. The hull of the Walton Belle is divided into nine watertight compartments, which subdivision renders her practically safe against foundering under any conceivable circumstance.

The accommodation for passengers is provided in the usual handsome and luxurious style peculiar to the fleet. The principal apartment is a "social hall," the framing of which is of polished oak and sycamore, with panels of lincrusta, the ceiling being painted and gilded to harmonize, and the entire apartment brightly lighted



TRIPLE EXPANSION ENGINES, STEAMSHIP WALTON BELLE.

by means of large windows. The sofas are upholstered in blue figured velvet, and arranged in bays, while the windows are curtained in blue and gold tapestry, the general appearance being that of a homelike drawing room.

The first class dining saloon, which is situated on the lower deck, has seating accommodation for one hundred persons at a time; the framing of this apartment is in yellow pine artistically painted, while the upholstering is in figured velvet harmonizing in color with the general decorative design of the saloon. As the total number of passengers that may be carried by the steamer is 1,500, another dining saloon is provided at the forward part of the vessel to supplement the main saloon when she is crowded. A saloon is also placed forward for the convenience of second class passengers. In addition there is a handsome boudoir for ladies, besides private cabins and private dining accommodation. The promenade deck, already alluded to, is fitted with comfortable seats, which are designed so as to serve as life rafts in an emergency. An installation of electric lighting is provided, and an elaborate system of ventilation. For handiness in navigating the upper Thames a bow rudder and suitable steering gear are fitted, while powerful steam steering gear is provided for the main rudder and controlled from the flying bridge.

The Walton Belle is propelled by a set of direct action, triple expansion, diagonal, surface condensing engines, with cylinders 20½ in., 30 in. and 43 in. and a 60 in. stroke. In order to secure both lightness and strength, cast and ingot steel, to the exclusion of cast and wrought iron, have been used wherever practicable in the machinery. The engine has three cranks, which arrangement tends to steadiness of motion. The high pressure and intermediate cylinders are fitted with piston valves and the low pressure cylinder with a double ported slide valve, all being worked by Brock's valve gear, which insures uniformity of lead at all grades of expansion. The reversing is effected by Brown's combined steam and hand gear, all the levers being brought to the starting platform.

Steam is supplied from a multitubular boiler, working at a steam pressure of 160 pounds, and constructed in accordance with the Board of Trade requirements. Forced draught arrangements are fitted in a closed stokehold, the air being supplied by a fan driven from a Bumstead engine. Denny & Company's patent spark arrester is fitted in the funnel.

The trial runs between the Cloch and Cumbrae lights on the Firth of Clyde gave a mean speed of 17·09 knots, as compared with the contract requirement of 16½ knots.

For our engraving and the foregoing particulars we are indebted to The Engineer.

LEGS OF RACING CYCLISTS.

Our illustrations show the front and rear views respectively of the legs of some well known professional cyclists. For years sporting journals have debated the question as to what is the form of musculature most desirable for a cyclist's legs, without arriving at any very definite conclusion. There is also a difference of opinion as to what part of the body has to bear the greatest strain. According to some physicians, the heart is brought into excessive action, while others hold just the contrary, that the work is rendered easier for that organ, by the task required of the other muscles, mainly those of the thigh, the cardiac spasms resulting more easily owing to the impulse given to the circulation. These advocates of cycling, moreover, state that, while other athletic exercises requiring great efforts and muscular work produce on the one hand an accumulation of carbonic acid gas, and on the other, through the frequent closing of the glottis, shortness of breath, in cycling there is no accumulation of carbon dioxide, the product of the combustion caused by the muscular work. The movement being distributed evenly over the body, the work is comparatively small, while the blood is freely supplied with oxygen by the frequent inhalations.

These details are given by Dr. Jennings. But the remarks surely do not quite apply in the case of prolonged or very rapid wheeling.

However, let us return to the subject of our illustrations. Photographs were taken of the limbs of these professionals, to establish whether they showed any analogous development. One glance at the cuts will convince the reader that such is not the case. Beside the fine anatomy of Jaap Eden, Lamberjack, for instance, shows no very remarkable build. Many noncyclists have as good thighs as Fournier, Gougoltz and Fischer. As for Huret, a stayer, strayed into the number of these sprinters, it is not his legs that distinguish him from the rest. One characteristic common to all is the abnormal development of the crural biceps and triceps, noticeable particularly in Jaap Eden. In him it becomes almost a professional deformity.

It is a pity that this reproduction in black and white cannot give fully the tint of the limbs. They are all spotted and scarred; on Lamberjack we notice a plaster at the knee. These are trophies from occasional collisions, such as occur on all racing tracks.

There seems to be no precise indication from which we can judge what is the ideal cyclist's leg. Medical men express no opinion on the question. Choppy Warburton, the famous trainer of Linton, Michael and Champion, alone has the confidence to make any assertion with regard to that question.

The professional cyclist, he says, must be an athlete. Any man who has had success in any branch of sports which requires endurance will also have triumphs on the track. Thus Eden was formerly a great skater. As for his bodily conformation, the cyclist should be built somewhat like a dog: a wide chest, in which the lungs can work freely; the lower limbs should present long, powerful levers, as in a greyhound. Zimmermann, the great American champion, had remarkably long thighs.

So much for the opinion of professionals. Our cycling readers may make their own observations from the two cuts which we borrow from L'Illustration, and form their own opinion accordingly. We will say no more, but leave them to study these assorted human limbs.

JAAP EDEN. FISCHER. PIETTE. LAMBERJACK. GOUGOLTZ. HURET. FOURNIER.

LEGS OF RACING CYCLISTS.

BRASS FACING ZINC HALF TONES AND THE METAL MOUNTING OF SUCH BLOCKS.

By E. L. Ectro.

As the unprotected surface of a zinc half tone is very liable to damage, many remedies have from time to time been suggested and tried. It has been found that a thin coating of brass has proved of great service in this direction, and an easy and simple way of depositing this alloy is here given.

Of the merits or otherwise of the hot or cold process it is not necessary to say much. Each bath has its adherents, and as both a hot and a cold bath formula is given in this paper, the worker can choose that which suits him best, as, with the exception of making up the solutions, the working is practically the same in both instances.

COLD BATH FORMULA.

Zinc carbonate	10	parts.
Copper carbonate	10	"
Soda carbonate	20	"
Soda bisulphite	20	"
Potassium cyanide	20	"
Arsenious acid (white arsenic)	1	"
Water	1,000	"

To make up the solution proceed as follows: Take twelve parts of sulphate of copper and twelve parts sulphate of zinc and dissolve them in water, then add carbonate of soda, already dissolved, to the solution. This precipitates the copper and zinc in the form of carbonates, a greenish colored powder. Allow the precipitate to settle, and pour off the supernatant liquor. Wash the precipitate, and then mix it with the carbonate and bisulphite of soda in 900 parts water. Next dissolve the cyanide and arsenic in the remaining 100 parts water and pour this into the first solution. The bath is now ready for use.

HOT BATH FORMULA.

Copper acetate	14	parts.
Zinc chloride	14	"
Potassium cyanide	30	"
Soda bisulphite	28	"
Ammonia	16	"
Water	1,000	"

Dissolve the cyanide and bisulphite in 800 parts water and add to it the other ingredients dissolved in the remaining 200 parts water. This solution is used at a temperature of about 120 deg. Fah. The vessel for containing this solution may be of iron lined with brass, and the temperature maintained by hot water, gas, fire, or steam. The cold bath can be used in an ordinary earthenware vessel, or, if the work runs large, a wooden tank lined with guttapercha will answer admirably.

The anodes should be of good stout brass. They should occasionally be removed from the solution to be cleaned, and the connections generally seen to. Care should also be taken to prevent any of the solution getting upon the hands or clothes; if such should happen, it should be immediately washed off with water.

A pair of Bunsen cells in series will be required to

deposit the metal. The cells and the method of connecting them were fully described in the issue for October, 1896, but for those readers who have mislaid that number a few brief notes are here given. The Bunsen cell consists of an outer earthenware jar containing a 10 per cent. solution of sulphuric acid. Into this a zinc cylinder amalgamated with mercury is placed. A porous pot with a block of carbon in it is filled with pure commercial nitric acid, and then placed within the cylinder of zinc, and the battery is complete.—The Process Photogram.

RAPID PROCESSES OF UNLOADING ARTILLERY MATERIAL FROM CARS.

The ordnance department is just now studying some rapid processes of unloading a battery from a train upon an open track and with its own resources. It is possible that, during the course of a war, a battery of artillery may have to be taken off a train in the open country without the aid of any of the arrangements and accessories that are found at stations for assisting in such an operation. The destruction of a track, the occupation of a station by the enemy and an unexpected attack are so many circumstances under which the artillery would have to be unloaded from the train under such conditions; so, in recent times, much attention has been paid to this question. Several processes have been studied and put to the test in France as well as in other countries. The one that appears destined to be adopted by us is that proposed by Capt. Barthelemy.

The photographs herewith reproduced represent different phases of the unloading of a battery by this method. These photographs were taken during the course of experiments made at Fontainebleau by one of the flying batteries of the seventh division of cavalry.

Capt. Barthelemy's system is based upon the following principles: (1) The utilization of the hind ladder of the forage wagon or of the artillery wagon separated from its forecarriage as an inclined plane for unloading the horses; (2) the descent of the fore and hind carriages of each wagon separately by manual labor, and, when either of them is about to touch the ground, the receiving of its hubs in some kind of support that will allow the wheels to come into contact with the earth without shock.

The unloading of the wagons of a battery will, of course, begin with the one that is to serve as a descent for the horses.

The best of the vehicles to use for this purpose is the forage wagon, which, on account of its length, gives a very gentle slope.

The artillery wagon, which gives a steeper slope, is used only in case of the absence of the forage wagon. After the wagon that is to be used as an inclined plane has been taken off the car, its fore carriage is removed, and there is thus obtained a very convenient gangway, so to speak, that just reaches the level of the floor of the wagons. Upon the floor of the wagon there is spread straw and sand, in order to render its surface less slippery.

Fig. 1 represents an unloading of horses effected by means of a battery wagon. The party that made the experiment during which our photographs were taken had no forage wagon at its disposal.

As the hind carriage of an artillery wagon is connected with the fore carriage by means of a short pole, it is the latter that rests upon the earth when the two parts are detached. The men seen at the two sides of the wagon are there to prevent any motion during the descent of the horses and to keep its upper part in close contact with the floor of the car. Further to the left is seen a man with a shovel ready to throw sand upon the floor as soon as the horse has been disembarked.

Fig. 3 represents the unloading of a fore carriage. By means of ropes possessed by the battery, the wheels have been tied, so that it will be impossible for them to revolve.

Two men placed upon the other side of the truck hold back the descending wheels by means of a rope. This rope makes one revolution around the axle of the truck, and this gives the two men considerable of a purchase. Ten other men cause the wagon to advance while holding it.

The accessory supports mentioned above have been prepared in advance and are as follows: With a forage rope there is formed a sort of sling which is placed upon the point of one of the large pickets that are carried under the artillery wagons and that are used for attaching horses to by means of ropes during a bivouac.

As soon as the axle of the fore or hind carriage that is descending reaches a distance from the earth a little greater than the height of the picket supports, one of the latter is fixed by its sling to each axle. The axle continuing to descend, the supports touch the earth. Then, instead of continuing to descend vertically, it pivots around the two points of the supports that rest upon the ground, and the tires of the wheels touch the latter without any shock.

The descent of the hind carriage of a wagon is effected in the same manner, with the difference that, as soon as it is possible, it is connected with the fore carriage that has already been unloaded.

Fig. 4 shows the descent of a hind carriage. The picket supports are here already fixed to the hubs. A gunner standing on each side holds each of the supports exactly vertical, in order that no sliding may occur when the carriage pivots around the bearing point of the supports.

All the wagons of the battery except the ammunition ones are unloaded as we have just explained. As the fore and hind carriages of the ammunition wagons cannot be separated, the latter have to be unloaded in their entirety.

In order to perform this operation everything is taken out of the wagon, and then its fore carriage is made to pass over the edge of the truck, while a sufficient number of men to balance it get on behind, so as to allow the front wheels to touch the ground without shock. The descent is effected entirely by manual power. Fig. 2 clearly shows the mechanism of this operation.

The unloading whose phases are here reproduced, and which included that of eighteen wagons and two hundred horses, took about two hours.—La Nature.

Fig. 1.—ARRANGEMENTS EMPLOYED FOR DISEMBARKING HORSES.

Fig. 2.—METHOD OF LETTING DOWN AN AMMUNITION WAGON.

WIND PRESSURES ON HIGH BUILDINGS.*

We have been particularly requested to lay before our readers an abstract of the long, but very valuable, paper on wind pressure prepared by Mr. Julius Baier, Assoc. Mem. A. S. C. E., but it has seemed best to us to print the following copious extracts from his paper rather than a briefer abstract:

The storm of May 27, 1896, entered St. Louis from the west, progressed eastwardly through the city at some distance south of the central business section, crossed the Mississippi River and continued in a northeasterly direction through East St. Louis. . . .

The anemometer record shows the passage of 13 miles of wind in about 12 minutes; of this, a little over 8½ miles passed in five minutes, a rate of about 80 miles an hour observed, giving, when properly corrected, an actual velocity of about 62 miles per hour. The general direction was toward the south, into the storm center. . . .

A general inspection of the buildings brings out the following average characteristic features. The extreme force of the wind was generally confined to upper stories and roofs. The intensity of this force must have been extremely variable, not only as exerted on adjacent properties, but on a single building. There was very general evidence of the destructive force being exerted from the inside.

The total number of buildings destroyed or seriously damaged by the storm in the city of St. Louis, as shown by the records in the assessors' office, is 7,263. Of these, 321 were totally wrecked. The number of houses slightly damaged that can be repaired at an average cost of $75 is 1,249, making a total of 8,515. . . .

The general maximum destruction covers an area from 4,000 feet to 6,000 feet wide and nearly three miles long, lying immediately south of the central part of the city in St. Louis and extending across the river into East St. Louis. . . .

Throughout the path of the storm the buildings and wreckage show evidence of extreme and sudden variations in the intensity of the wind pressure. A striking example of this is a little pavilion left standing in Lafayette Park on a slight elevation above the general level, at a point where the broken and uprooted trees show the full force of the storm. A straw thatched roof held in a light wire netting and perched on six uprights planted in the earth, and stiffened by a few rustic braces, would seem a most inviting mark for the wind, but except for some damage due to the falling limbs of adjacent trees, it stands uninjured. . . .

Any formula expressing the relation between the pressure and velocity of the wind must be based on the assumption that the air flows in a uniform current. All experiments in the open air show that the actual conditions are far different, and the great diversity in the observed results is due largely to the continued and rapid fluctuations in the velocity of the winds. . . .

As a result of these observations Professor Langley reaches the conclusion that "the wind is not even an approximately uniform moving mass of air, but consists of a succession of very brief pulsations of varying amplitude, and that, relatively to the mean movement of the wind, these are of varying directions."

Regarding the direct effect of wind pressure on buildings, some suggestive results were obtained by Professor Kernot* with an apparatus devised to determine the relative pressures of the wind on flat plates, cubes, cylinders and other forms similar to those employed in ordinary construction. A steady jet of air 10 by 12 inches in cross section was directed against small models supported on a very delicately arranged carriage running on an accurately leveled surface plate, the force exerted being measured by a delicate spring balance. From a large number of experiments made with this apparatus he found that the pressure on sloping roofs agreed with the results of theory only when the air could blow freely underneath. With the model of a roof placed on a wall, as in an ordinary building, the air was deflected upward and greatly reduced the pressure on the roof; the effect was more marked when a parapet was used. In the case of a roof of 30° pitch, with a parapet 0·16 the height of the roof, the pressure was actually reversed, the roof having a slight tendency to lift. Experiments were tried as to the effect of the wind blowing in at the open end of a building having the sides and other end completely closed, and it was found that there was an internal pressure, tending to lift the roof and force out the sides,

* Extracts from a paper by Julius Baier, Assoc. M. Am. Soc. C. E., read before the American Society of Civil Engineers, and published in the Journal of that Society.

* Engineering Record, February 10, 1894.

which was equal to the pressure of the wind on the exposed end. When a plane surface parallel to the wind was brought nearly into contact with the cylinder, the pressure on the latter was increased nearly 20 per cent, owing to the lateral escape of the air around the cylinder being checked, showing that a tower or chimney will be subjected to a much greater pressure if there is a building nearly touching it on one side. The variations of pressure caused by the proximity of other surfaces were very marked; each surface appeared to affect the pressure on the other surfaces to a distance in front equal to its own breadth, and in the rear equal to several times this distance. Behind flat surfaces eddies were found to exist which caused other surfaces placed behind them to be urged forward with considerable force.

The existence of a suction on the leeward side of surfaces or bodies exposed to the wind has been generally recognized, but the experiments of Mr. Irminger,* a Danish engineer, made to determine the amount of such suctions, shows it to be present to an unexpected extent. . . .

The most interesting result was that found for a roof sloping at an angle of 45°. The pressure on the windward side was a maximum at the eaves, and became zero near the top, changing to a suction at the ridge. The effect on the leeward side was a uniform suction. Taking the normal pressure on a plane of the same dimensions as equal to p, the proportional effect on the windward side was found to be a pressure of 0·11 p, and on the leeward side a suction of 0·36 p. The resultant effect on the total roof was a force 3½ times as large as the pressure on the windward side alone, and was inclined upward, exerting a strong lifting action. In another experiment made with the model of a building covered by a dome, the resultant of the pressure and suction upon the dome was found to act vertically upward.

The results of these experiments show that the wind acts in a direction quite different from that generally assumed and usually provided for in the designing of bridges, roofs and buildings. The evidences at St. Louis confirm this conclusion. . . .

Much of the destruction in St. Louis was undoubtedly caused by an intensity of wind pressure that it would be neither possible nor expedient to provide against in ordinary structures, but much of it was also due to weak construction. A general observance of the ordinary requirements for good building work would largely decrease the damage due to such storms. The great amount of explosive action was largely due to the comparative weakness of ordinary walls against pressure exerted from the inside of buildings. A more efficient anchorage of the walls might limit this explosive action to the windows. In numerous instances the windows were blown in on the windward side, while the entire wall was blown out on the leeward side. Brick walls are materially stronger if well bonded with the vertical joints filled with mortar, and a wall laid in cement will undoubtedly withstand a greater lateral force than one laid in lime mortar. It is worth noting that the walls of the buildings of the Union Depot Railway plant left standing were laid in cement, while the older buildings, which were entirely wrecked, had had walls laid with lime mortar. The great damage done to the churches calls attention to the great exposure of the steep and lofty roofs supported on high and comparatively thin and unbraced walls. Heavier buttresses or independent steel column supports, with bracing for the roof trusses, would materially increase the safety of such structures. In general, the buildings with large areas of unbraced walls have suffered most. . . .

The periodic prevalence of these storms, emphasized by the recent calamity in St. Louis, by the destruction in Louisville in 1890, and by a similar storm in Little Rock in 1894, and in Kansas City in 1886, gives a somewhat broader public interest to this question, and appears to call for its serious consideration. The evidence of the work of the wind in St. Louis suggests as an immediate answer to the question that it will depend largely upon the nature of the metal framework in the building. . . .

The metal framework of a building is somewhat generally called the "skeleton" and sometimes "cage." If both of these terms are to be retained in this special sense, a convenient distinction can be made by some restriction in their use suggested by the words themselves.

Skeleton is a term clearly descriptive of that type of construction to which it was first applied, a simple framework of columns and beams whose efficiency is dependent largely on the existence of exterior walls and partitions which brace the building, and hold the framework in position, just as the utility of the human skeleton is dependent upon the covering of sinews and muscles that hold the component parts together. On the other hand, the light framework of an ordinary wire cage bound into one compact unit is suggestive of an inherent strength and elastic resistance that renders any covering an incident rather than a necessity. Cage is a term peculiarly descriptive of that type of construction represented by the most advanced and approved practice, a framework of columns and beams, spliced at the joints, riveted at the connections, stiffened by an efficient bracing of rods, portals and gussets that make it independently safe against any external force, leaving the thin and light exterior walls with no duty except that of providing protection and ornamentation for the building.

The effect of an extreme wind pressure on a high office building with curtain walls must depend largely on the extent to which the frame of that building partakes of the nature of the skeleton type or the cage type of construction.

The possible work of destruction of a tornado may appear more clearly if, as Ferrel suggests, the column of rapidly revolving air is likened to a tall flue, with heated and rarefied air in its interior. If the access of air is cut off from the lower central part by the shell of gyrating air extending down to the surface, the lateral currents and ascending currents in the interior will be of no violence, but with a somewhat free access of air below into the rarefied interior, on account of a decrease by friction of the gyratory velocity near the surface, the inrush of lateral air currents becomes extremely violent and the velocity of the uprush of air in the interior becomes enormous. In the former case, the destruction is mainly due to the excessively high gyratory velocities; the destruction is complete, but the path narrow. It is the condition that may prevail in open country with but few objects to destroy the energy of the tornado. In the latter case the destruction is largely due to the violent lateral inrushing currents. The path is wider, and the force not so extreme. It is the condition which must prevail in any compactly built city, owing to the great friction of the air arising from the irregularities due to the many buildings.

The first high isolated building encountered will feel the full force of the gyratory velocity, but the resistance of the building destroys this velocity, and the work of destruction wrought on that building must represent an equivalent diminution of energy in the lower section of the tornado, which can only be renewed by its further unobstructed progress during such appreciable time as is necessary to restore the gyratory velocity. A succession of high buildings will prevent such recovery of velocity.

The destructive power of a tornado on massive building work due to these excessively high velocities is therefore soon exhausted, but the wind pressures due to the violent currents rushing in from all sides are only intensified thereby.

If a tornado storm with a well developed whirl should pass through the section of any city containing very high buildings, the general level of the top of the lower buildings becomes equivalent to the ground surface, and it seems fair to assume as the result the same general action that has been found near the surface, modified or intensified in its irregularity according to the degree of uniformity in the general height of the majority of the buildings. There may be the extreme pressures due to the gyratory velocity of the tornado proper exerted over a limited area and for a very limited time. There will be a far wider zone of lateral inrushing winds at high velocities lasting throughout the progress of the tornado and attended by the additional complications that may arise due to the concentration of air currents in the deep valleys formed by the streets between the buildings. The probable result would be an extremely variable and intense action of the wind about the tops of the lower buildings, the same action concentrated locally at about that level on the higher buildings, accompanied with a general severe pressure over the entire exposed area of the latter, this latter pressure probably being a maximum near the top or at least some distance above the general level where the friction is not so great.

A characteristic feature of the St. Louis tornado, and one which, judging from records and published views, is also common to other tornadoes and violent hurricanes, is the general destruction of the ordinary brick and stone walls. Regardless of the sequence in which they may explode outward or are blown inward, and of a possible difference of opinion as to whether the explosion is due to a plenum, a vacuum or to a suction, the essential fact remains that the walls do very generally fall.

Assuming a similar action of the wind, the buildings of an average height will probably have the walls at the top or exposed corners destroyed, or, if particularly weak, may be shaken down. The buildings above the average height would be very liable to have part of the walls at any level blown in or taken out. An office building with the curtain walls of one or more stories removed would support the remaining enveloped superstructure precisely in the manner of the grain elevator before it was struck by the storm.

If now the building is of the pure skeleton type, it will have only the elements of stability that existed in the case of the elevator—its weight—above the floor in question, and possibly some additional bracing of a more or less uncertain value, and under the action of even such pressure as may exist at some distance from the vortex of the tornado, it will fail, just as the elevator failed; it will topple over and fall to one side or toward one corner on the floor below. Instead, however, of landing on a massive stone foundation, the thousands of tons of weight of the three, four or six stories, as the case may be, of the upper section of the building will fall with a crushing force, concentrated on the leeward side, on the section below. The heavy oak girders under the leeward edge of the elevator were mashed into a bundle of splinters, while the windward edge was held some distance above the foundation. As the striking force of a freely falling body is equal to the product of its weight multiplied by the distance through which it falls—about 12 feet in the case of an office building falling one story—the resulting pressure on some of the columns may easily be ten to twenty times the load they were designed to carry and several

FIG. 3.—REMOVAL OF A FORE CARRIAGE FROM A PLATFORM CAR.

FIG. 4.—REMOVAL OF A HIND CARRIAGE FROM A PLATFORM CAR.

* American Architect, September 14, 1896.

times their ultimate strength; the result must be a collapse of part or all of the lower section, with a possible toppling over of the upper section to one side into the street or onto a lower adjacent building.

If the building is of the cage type, it will stand safely under a wind pressure that will destroy the skeleton building. While the failure of the walls at any story may reduce the rigidity somewhat, it cannot affect the strength of a framework designed without placing any dependence on the covering. Such a framework will readily carry the lateral stresses from the upper section to the section below.

If the pressure should reach a destructive intensity, the exact line of yielding of a cage frame is not so clearly defined. The tendency to lateral displacement will be a maximum at some one story, depending on the distribution and cumulative effect of the wind pressure, aided possibly by the weakening due to localized failure of walls or partitions. As the frame is of a gradually varying strength from the top down, the distortion can hardly be confined to one level, but would probably involve the members of the adjacent stories, the effect being a general racking or leaning of the building. With strains near the ultimate strength, the failure at some point may concentrate a distortion at that level, and the upper section of the building may be pushed to one side and ultimately settle down on the floor below.

The essential difference lies in the fact that a wind of sufficient force and duration to push the upper section of a building to one side a distance about equal to the width of a column may cause total destruction in a skeleton building, while a cage under the same circumstances may suffer only a local damage that can possibly be repaired at a comparatively small cost. In a skeleton building, the instant the columns are pushed beyond the critical or balancing point, the weight is reversed in its action from an element of safety to an almost unresisted element of destruction. With a cage type of construction the weight of the building after some displacement has taken place also acts with the wind as a destructive agent, but not unresisted. The work that must be done in the necessary bending, twisting, and general distortion and breaking of the metal in the columns and beams must largely absorb the energy of the falling mass and have the effect of letting it settle down on springs. The local peculiarities of the building, the unequal distribution of the wind pressure, and the changing direction of the wind, make it more than probable that such failure will not be symmetrical, but will have a torsional effect on the upper section of the building.

However difficult it is to foresee the many possibilities, it is safe to assume that in one way or another the framework will hang together sufficiently to prevent any considerable part of the building from falling down bodily onto streets or buildings below. Even under the most extreme conditions it is difficult to conceive how such a building, or a large part of it, can entirely collapse. The general destruction of windows and walls will greatly relieve the wind pressure; the frame, partly bent, twisted and distorted, must still hold together. The chances are that most of the occupants will escape alive and many uninjured. The most striking feature of the St. Louis tornado is the countless number of hairbreadth escapes and the very small number of people killed inside of houses unless by the entire collapse of the structures; incredible as it may seem, under such extreme conditions, the fatalities attending only local failure of a building are comparatively few.

The effect of a destructive wind pressure on any high building with curtain walls may be assumed to approach that outlined above in proportion as its framework partakes of the nature of a skeleton or cage type of construction, using these terms in the restricted sense indicated in this paper.

The destructive effect of the total collapse of buildings has been too frequently noted to require further mention. The method of failure of the grain elevator, taken in connection with the view of the wreck of the skeleton framework, indicates what might happen to a high building of the pure skeleton type if brought to the point of failure. The assumed action of the cage type of building is dependent on an efficiency in general design, and particularly in the detailing of connections, which can be readily attained if the necessity for it is recognized. In the absence of any definite tests of full sized typical details used in the structural work of buildings, the action of the metal under extreme distortion must be estimated from the results shown by sample specimens, verified by occasional opportunities to notice its behavior under accidental tests of great severity that may be caused by collisions or derailments on or near bridges and viaducts. The riveted joints, mentioned earlier in the paper, show what may be expected in details involving similar principles of design.

The possibility of a high office building being actually subjected to a destructive wind pressure has often been considered, largely in the light of a theory. The St. Louis tornado passed within less than a mile of the office buildings in that city. Fortunately it made no test of the buildings, but it has left some definite evidence of the possible force of the wind and of the action of this force on the materials of construction. While it raises anew the question as to the amount of wind force which should be provided for in designing high buildings, it raises with more emphasis the question as to the method of providing for this force after its amount has been assumed. Any dependence placed on curtain walls and partitions for lateral strength is open to very grave question. The rigidity imparted to a building by the simultaneous action of the total mass of material under ordinary conditions is no indication of the ultimate strength that may be developed at a critical moment, and the very general failure of the walls under extreme wind pressure further destroys any certainty of such assistance as might be otherwise relied upon. The elements of safety against wind force, exclusive of the strength that may come from the walls and partitions where they exist, are the stability due to weight alone, stability due to the strength and stiffness of the frame, and, when the force is a sudden one, the inertia of the mass resisting motion.

It may be of interest to estimate just how sudden and how short lived the force must be to justify placing any dependence on the inertia of the structure for safety. The force required to set in motion and move over a given distance any mass, otherwise balanced, is capable of exact computation if the time allowed for such motion is known. The equation is derived from the law for falling bodies and is $F = \frac{2\,w\,d}{g\,t^2}$, where F is the total force, w the weight moved in pounds, d the distance moved over in feet, t the time in seconds, and g is 32·2.

The following table, computed from this formula, gives the force required to overcome the inertia of a ton of 2,000 pounds and move it varying distances in times varying from one second to thirty seconds.

FORCE PER TON REQUIRED TO OVERCOME THE INERTIA OF AND MOVE ANY GIVEN MASS.

Time in Seconds.	Distance Moved.									
	1 in.	3 in.	6 in.	1 ft.	2 ft.	4 ft.	6 ft.	8 ft.	10 ft.	16·1 ft.
1	10·3	31	62	124·22	248	497	745	994	1,242	2,000
2	2·6	7·7	15·5	31	62	124	186	248	310	500
3	1·15	3·4	6·9	13·8	27	55	83	110	138	222
4	0·64	1·94	3·9	7·7	15·5	31	46	62	77	125
5	0·41	1·24	2·4	4·9	9·9	19·8	30	40	49	80
6	0·28	0·86	1·72	3·4	6·9	13·8	20·7	28	34·5	55
8	0·16	0·48	0·97	1·94	3·8	7·7	11·6	15·5	19·4	31
10	0·10	0·31	0·62	1·24	2·4	4·9	7·4	9·9	12·4	20
15	0·046	0·14	0·27	0·55	1·10	2·21	3·3	4·4	5·5	8·9
20	0·026	0·078	0·155	0·31	0·62	1·24	1·86	2·5	3·11	5·0
30	0·012	0·035	0·069	0·138	0·28	0·55	0·83	1·10	1·38	2·22

Assuming, as an illustration, the weight of a ton suspended as a pendulum by a very long cord; then to swing it one foot in one second will require a force of 124·2 pounds, while the mere pressure of 1¼ pounds will accomplish the same result if the time allowed is 10 seconds, or about the average duration of a gust of wind in Prof. Langley's experiments. Applying the figures in the table to the case of a narrow building, say 32 feet wide, and assuming the upper section 100 feet high by 100 feet long, having thus an exposed area of 10,000 square feet to weigh 5,000 tons, then the force necessary simply to overcome the inertia and move this part of the building the respective distances of 1 inch, or 1 foot, or 16 feet, in various intervals of time, is equivalent to a pressure per square foot of the exposed areas as follows:

t.	d = 1 in.	d = 1 ft.	d = 16 ft.
	Lb.	Lb. per sq. ft.	Lb. per sq. ft.
1 second	5·2	62·1	1,000
2 "	1·3	15·4	250
3 "	0·5	6·9	111
5 "	0·2	2·5	40
10 "	0·05	0·6	10
15 "	0·02	0·3	4·4

These figures will readily indicate how great a resistance the inertia of a building may offer against the motion necessary to overturn it under the action of a brief gust of wind, and how comparatively little this resistance becomes as against only such motion as is necessary to push it over on its supports. To overturn the building in ten seconds, a pressure of 10 pounds per square foot is necessary to give it the necessary motion, in addition to the force required to overcome its stability. The resistance of inertia for a movement of one foot against a gust five seconds in duration will be 2·5 pounds per square foot, and for ten seconds it will be only 0·6 pound per square foot. For shorter periods the value of inertia becomes very high, but may, on the other hand, be entirely overbalanced by the cumulative effect of the vibrations of the building acting in rhythm with the pulsations of the wind. Experiments on Chicago buildings under heavy winds show the time of a complete vibration to be about two seconds. The resistance of inertia against the destructive effect of brief but intense pressure, such as the gyratory velocities in the vortex of a tornado, is fortunately very great.

Stability due to weight alone is proportional to that weight and to the breadth of base of the support. Its value as an element of safety is a most definite one and may be sufficient. Considered with reference to overturning, a large elevator or building may be safe beyond question, yet with reference to its column supports the same structure may be in comparatively unstable equilibrium, as a relatively small movement of the center of gravity will throw it out of balance. The total force required to overturn a building of a given weight increases directly with the breadth of that building, but the total force required to push it over on its supporting columns is a constant, depending solely upon the height and breadth of base of those columns, and is independent of the dimensions of the building, of the number of supporting columns, or the material they are made of. Any structural member that is used simply as a prop or support can have only such value as is incident to that use, whether it is made of wood, of stone, of cast iron or of steel.

The elements of strength and safety inherent in a well designed cage built of the proper material, with all its members thoroughly riveted together, are present in that frame in greater or less degree, until it is torn or cut apart, piece by piece. A steel frame built to be safe for a wind pressure of 30 pounds per square foot, proportioned by unit strains of one-half the elastic limit, would probably withstand a pressure from 40 to 80 pounds per square foot before the frame yields. This range depends largely on the care with which the connections have been detailed, the extent to which possible unequal settlement of the foundations has already overstrained the frame, and on the reduction of the effective surface exposed to the wind by the destruction of the walls in the panels between the framework, leaving part of the wind to blow through unresisted.

The details of construction that provide lateral strength and safety against an assumed wind pressure are of the first importance. The subject of this paper, however, suggests a further consideration of these same details of construction, assuming that they may be strained by wind pressures beyond their safe limits. If a building is never under any circumstances to fail, the problem is completely solved as soon as it is designed to stand under the assumed pressure. Assume that it may some day be brought to the point of yielding, and immediately some pertinent questions arise as to the possible results.

While the destruction and loss of the upper section of a building may be a matter of serious consideration to the owner, the disposition which a tornado would make of that section of the building may be an equally or more serious matter to the adjoining property owners. If it is impossible to foresee the extreme force of the elements, or impracticable from economic reasons to provide against them entirely, it certainly is rational to make such modifications in a design as will reduce the possible disaster and damage to a minimum. A very material increase of safety in this direction can generally be secured at a comparatively small additional expense, depending largely on the attitude of the designer to the problem. The design of a building to be subjected safely to a given wind pressure and never to any more is a definite problem involving only arbitrarily fixed working stresses. A design of that same building for the same condition of safety, but with the further recognition of the fact that it may be exposed to destructive pressures and with an effort to develop the ultimate strength and resistance of the material in the cage to resist those pressures, is a problem that will develop some additional considerations.

A destructive lateral force exerted against the upper section of the building will not be lost or dissipated, but must follow some well-defined path till it reaches the foundation. If a building is to fail laterally, then the ultimate strength of members under the action of lateral forces becomes of the first importance. Upright members are no longer simply columns, but are more properly considered as vertical beams carrying some initial load, and, viewed in that light, must have all the essential elements of a good beam. The unequal straining and successive failure of the rivets, due to their unsymmetrical distribution in the connections, may become an important element of the design when the stresses are sufficient to overcome the averaging effect of the frictional resistance. The relative values of the ultimate or elastic limit stresses may suggest details at the connections somewhat different from those indicated by the fixed ratios of assumed working stresses.

A brief analysis of possible results applied to the definite circumstances and conditions of any particular building may suggest probable failure along one or several well-defined lines, and as readily suggest modifications that will materially increase the strength of the structure, or at least define and limit the amount of destruction.

The amount of metal required for an efficient system of wind bracing is but a small part of the weight of the metal in the entire frame, and the cost of the latter is only about 10 per cent. to 20 per cent. of the expenditure for the entire building, exclusive of the site. The cost of the wind bracing can represent, therefore, only a very small proportion of the total capital invested. When it is considered that any additional metal used to strengthen the cage as a precaution against wind force is equally effective against possible damage due to earthquake shocks, or to the unequal settlement of the foundations, and is also an additional margin provided against the weakening effect of corrosion, the slight increase in cost must appear trifling as compared to the amount of the entire investment and the additional protection secured for the property.

It is somewhat unfortunate that the merits of the design of the framework are not so readily apparent to the investor, and that this part of the structure is of necessity immediately covered and permanently concealed from view. If the difference in strength and security due to the construction of the frames of some of these great buildings was as generally evident as, for instance, the difference in strength due to the varying thickness of solid masonry walls was in older forms of construction, there would probably be a more general recognition on the part of the owners of the need of securing the best type of framework.

A discussion of the safety of high buildings is applicable to other high structures, such as chimneys, shot towers, water towers, etc., and suggests that the development of the cage construction in buildings to its present advanced type makes it equally available for other structures of the kind named above. Monuments built with no consideration of expense will find ample security in their weight, but for any high structure in which cost and security are both of importance, the cage type of construction is thoroughly applicable and may have special advantages. The saving of material in the walls, and particularly in the foundations, may more than equal the additional cost of the steel work when designed for the same strength and security. The objection to any open tower built of structural metal work in a city, on the score of its inherent ugli-

ness, is removed by adopting such treatment as the architects have developed in the design of high office buildings. Any shaft or high structure that has lines of stability can be readily supported on a steel cage that will not interfere with its outlines, with probably a great gain in safety.

The amount of wind pressure to be provided for in the design of high buildings will no doubt be variously estimated, depending on the weight given in the judgment of the designer and of the owner of the building to the probability of exposure to such pressures. The statistics as to the frequency of tornadoes show that the possibility of their occurrence cannot be entirely disregarded without assuming some appreciable risk. While the atmospheric conditions which are favorable to their formation are more common in some regions than others, it is impossible to feel assured of entire immunity from their occurrence in any city. Tornadoes usually occur as local manifestations accompanying severe storms of great extent. On the date of the Louisville tornado there were ten others in the four adjacent States. On April 11 and 12, 1896, there were nineteen tornadoes in ten States attending severe storms, reaching from Mississippi to Michigan. The St. Louis tornado was but one of a number accompanying a general storm that moved through Missouri and Illinois. As far as known, it was not more violent than many others that have been observed. Its great destructiveness was merely incidental to the fact that its path crossed a territory embracing a large and closely built city. It gave evidence that wind pressures existed at least equivalent to or greater than 30 pounds, 58 pounds, and 85 to 90 pounds per square foot over considerable areas. Whatever the actual distribution may have been, the effects were those of such pressures uniformly distributed over the areas of the respective structures. These pressures were measured by their results in exactly the same manner in which they are ordinarily assumed to act, with the consequent elimination of all uncertainties usually involved in readings of pressure gages or deductions from anemometer records, and they are to that extent positive and definite. In addition, there were indications that a pressure of somewhere from 20 to 40 pounds was quite general over a comparatively wide area in, or adjacent to, the path of the storm, and that the pressures at higher altitudes were more severe than those measured.

In view of these facts it appears to the author rational to assume:

First. That the safety and interests of the community and of the owner of the building require a recognition of a wind pressure of at least 30 pounds per square foot against the exposed surface of the building, with an additional local provision of 50 pounds for several stories near the top; and that this amount should be safely taken care of by some positive and definite provision in the construction of the frame.

Second. That the vast interests at stake, the amount of capital invested and the comparatively small additional expense necessary would suggest to the owner the desirability of increasing the provision to 40 pounds per square foot.

Third. That the other uncertain elements of safety due to the ultimate strength of the material, the inertia of the mass, and the bracing effect of walls and partitions, should be recognized only as providing against the uncertain and possibly higher pressure of the wind which may occur.

The chief justification of much that seems bold or questionable in the construction of some high buildings lies in the fact that, as yet, none have failed. If the safety of such great structures is to be determined entirely by the logic of the fitness of the survivor, based on a brief and favorable experience, rather than by a rigid analysis, by tried and accepted principles of engineering design, it may ultimately lead to some very deplorable results.

By such a test the little summer pavilion in La fayette Park must take precedence over the approach to the Eads Bridge, for it survived the tornado and is standing yet.

DUSTLESS ROADBEDS.

The West Jersey and Seashore division of the Pennsylvania Railroad system has inaugurated a new method of treating the surface of its roadbed, the object being to prevent the lifting of dust by trains. The invention, which is patented by the assistant engineer of the company, Mr. James H. Nichol, consists of the application of a heavy oil of low cost, the product of petroleum distillation. This oil being applied to the surface of the track and roadbed, including the sides of slopes in cuts, fastens the loose particles of the surface together, and prevents them being lifted by the rush of air caused by the train.

Mr. Nichol has proceeded on the theory that gravel is not only the least expensive form in which ballast may be obtained, but is also the best, provided its dust creating feature is abated. Upon the subject Mr. Nichol writes to the Railway Age as follows:

"Probably from the first building of railroads gravel such as is found along the lines of the roads has been used for ballast, and if of proper nature, porous and free from clay or loam, so as not to retain water, is one of the best substances yet used; track laid on such a foundation is elastic, therefore making the riding in cars comfortable as compared with the more rigid stone ballast. This same elasticity is a benefit to the ties and particularly to the rails, the latter, when placed on a rigid support, being in the position of a piece of metal between an anvil and a hammer, the hammer being the moving train.

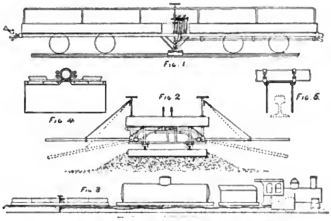
"Track laid on gravel ballast is more quickly and cheaply repaired than when on stone, the cost for ordinary maintenance and for labor in renewal of ties being about one-half.

"The principal reason for the discarding of gravel ballast on many railroads has been the discomfort to passengers arising from dust. As substitutes, various materials have been used, such as cinder from anthracite and bituminous coal, burned clay, crushed stone, etc. Each of these substances has some dust connected with its use, stone having the least. Cinder ballast is thought by some to affect injuriously the life of the cross ties, rotting the wood with which it comes in contact. Stone ballast, when first applied, and after being washed by rains, is clean and free from dust until such time as it becomes filled with material, largely cinders, thrown from the stacks of freight trains, and in this condition requires to be forked out and cleaned at large expense; the tamping of the ties, to obtain and preserve a level surface of the rails, results in the stone being crushed under the ties; and, if of a limestone character, a condition resembling a cement trough is formed under each cross tie, which catches and retains rainwater, causing the tie to decay.

"Cinder ballast, after being newly applied, requires several rainstorms to wash it free from dust, and then it is reasonably clean until the work of surfacing of track or renewing the cross ties stirs up the cinder from below the surface and exposes a new layer of dust. After a few years' use cinder becomes pulverized by repeated tampings, and is then a more objectionable dust than that from gravel, being dark in color. Experience shows that the oil produces equally good results with cinder as with gravel or sand."

The apparatus used in treating the roadbed with oil is illustrated in the accompanying engravings. For distributing the oil an ordinary flat car is fitted with one fixed pipe extending the length of the cross ties, and two swing pipes—one on each side—which, when extended, will reach two or more feet up the sides of slopes in cuts. Each pipe is controlled by a gate valve worked by a lever. A supply pipe extends the length of the car and a rubber hose connects with the four inch outlet in the ordinary tank car. A locomotive engine moves both cars and furnishes steam or compressed air to aid in ejecting the oil when thickened by cold weather. The flat car has box for tools, extra parts, etc., and is partly covered with an awning to protect the men. The sprinkling pipes are slitted for the oil to escape. The sprinkling car is furnished with shields, which cover and protect the rails from any oil which might drop or be splashed onto them. One end of the supply pipe on the sprinkling car is fitted with a connection for three or more lengths of hose, each terminating in a valve and spreader, for use by hand in covering sides of slopes in cuts.

The quantity of oil used is two thousand gallons per mile. In practice, on the West Jersey road, ordinary commercial tank cars holding six thousand gallons each are distributed at sidings about three miles apart, and are picked up as needed, the empty car being left.



OIL SPRAYING APPARATUS FOR ROADBEDS.

Fig. 1.—Sprinkling Car. Fig. 2.—End Elevation of Sprinkler. Fig. 3.—Diagram of Train. Figs. 4 and 5.—Details of Rail Shield.

The speed of the train at work is about four miles per hour.

In addition to the principal advantages claimed for the system, viz., the comfort of passengers and the reduction of wear and tear on bearing points of the rolling stock, the avoidance of hot boxes, etc., a point is made in regard to the preservation of ties and the general improvement of the roadbed, from the fact that rainwater is shed from the ties and ballast and runs off into the ditches instead of penetrating the ties and below the surface of the ballast. It is, therefore, expected that less labor will be required to keep the track in condition as to surface. The growth of vegetation in the ballast is also checked. The oil used is non-combustible, and has but little odor at first, and this is said to be lost on a few days' exposure.

The use of oil was commenced in April last. At the present time (August) there is something over one hundred miles of single track treated on the West Jersey and Seashore Railroad. The Philadelphia, Wilmington and Baltimore Railroad is building a sprinkling car in preparation for extended use, and beginnings have been made in the use of oil by the Philadelphia division and middle division of the Pennsylvania Railroad, also by the Amboy division of the same company.

Mr. Nichol gives the following account of the experience had with the treatment up to the present date:

"On the West Jersey and Seashore Railroad, which was the first to adopt the method, three months' exposure of track treated once shows a penetration in gravel ballast of three to four inches, being greatest where the gravel has least clay or loam in its composition. Walking on this ballast colors the sole of the shoe with oil; the ballast itself is not picked up on the shoe, but is pressed into the ballast beneath, a slight impression being made by the foot. When trains pass at speed no dust whatever is lifted, the track is not only practically dustless, but is absolutely so. The oil has penetrated the cross ties from one-eighth to one-half inch, according to the closeness of the grain of the wood. All of the ties are of oak.

"At a number of places track surfacing has been done after the application of the oil without creating dust, there having been a sufficient amount of ballast impregnated to prevent dust. This summer's experience has demonstrated that one application will last at least one season, and indefinitely thereafter or until ballast is broken up by renewals of cross ties. It is confidently expected that two or not more than three applications will suffice for years, as the ballast will be impregnated to and below the bottom of the cross ties, and renewals of the latter will not cause dust to be turned up."—The Railway Age.

[Continued from Supplement, No. 1129, page 18047.]

THE UTILIZATION OF ALUMINUM IN THE ARTS.

Aluminum seems to be particularly adapted for surgical instruments and processes, and considerable has been sold for such purposes, including handles of saws, knives, speculums and surgical apparatus generally. It is not corroded by antiseptic agents. Aluminum has also been used in tracheometer tubes and metal appliances placed in contact with living tissues. Someone has an aluminum blade four inches long placed in his jaw to take the place of the jaw bone. He eats as well as ever with his aluminum jaw bone.

A bicycle called the aluminum bicycle has been sold upon the market, the whole frame being cast solid in one piece, with quite a number of the parts hollow, and frames have been made of aluminum tubes brazed together by a secret process.

A good deal of talk has been made in Europe about alkolite; another alloy is romanite. All these various alloys are mainly pure aluminum, hardened with a small percentage of other ingredients, usually less than ten per cent. The composition can readily be told by analysis in most cases. Copper and nickel, while hardening aluminum to some extent, do not render it as hard as some other ingredients. Where extreme hardness is desired, zinc, manganese and titanium give much more satisfactory results, although each, unfortunately, renders the metal more brittle than does nickel or copper alone.

In Great Britain aluminum tubes are used which are drawn on mandrels and have the advantage over the worked metal in both strength and ductility.

The Pittsburg Reduction Company have orders for casting brake shoes for 80,000 bicycles; also orders for the rims of wheels for over 100,000 bicycles.

Aluminum is being used successfully for lithographic work, the light plates being used instead of the lithographic stone, as in the past.

Lithographic work has required a peculiar stone, which is only found in special places; and the stone has to be used in thicknesses of at least an inch to two inches, and the plates are very heavy and hard to manage. With the use of light aluminum plates a very much larger number of impressions are made.

For letters and signs, aluminum has become quite extensively used, not only in the shape of fine powder or bronze, but also in heavy cast letters, which can readily be attached to glass as well as wood.

Aluminum has not been used, but has been proposed for the fabrication of passenger coaches, both in the roofs and sides of cars, as well as in the fittings around the windows. Handle bars for city railway car brakes are now made of aluminum. With handle bars made of brass, the corrosion of the metal occasions sore eyes and affections of the mucous membranes, due to the poisoning action of the copper salts.

Aluminum bronze powder is finely powdered aluminum. In the cheaper varieties now sold on the markets it is adulterated often with fifty per cent. of tin. Pure aluminum, being entirely unacted upon by sulphureted hydrogen, is more durable and superior to silver powder than the article adulterated with tin. There used to be a considerable amount of silver powder used in the arts for various purposes, where now aluminum powder has entirely replaced it.

Owing to the extreme malleability and ductility of aluminum, sheets of the pure metal are now produced of only [illegible] to [illegible] of an inch in thickness.

Cast aluminum bath tubs, sinks and similar plumbers' appliances are being made.

It is used extensively for oil cups where reciprocal motions are made, the light weight being advantageous.

The use of aluminum in the galvanizing bath has become universal to produce the best and most economical grades of galvanized work. This aluminized zinc is used in such proportions that the total amount of aluminum in the bath will be only a small proportion—about 5 per cent. of aluminum to 95 per cent. of zinc in the alloy. These proportions vary according to the grade of zinc which is used; also to the class of metal to be galvanized.

Aluminum is largely used to improve the quality of brass castings. Aluminum has been added to the brass

to strengthen it, in all proportions from $\frac{1}{10}$ of one per cent. to 10 per cent., and the best results have been obtained in using aluminized zinc (first suggested by Mr. Joseph Richards).

Adding aluminum to brass mixtures has caused the brass to give dirty castings. This really means the attempt of the aluminum to purify the brass from these properties of lead and zinc. With pure, good brass, aluminum does not form this dross nor make black, unsound castings.

Used in proportions of 5 to 10 per cent. with copper, it forms aluminum bronze, one of the most dense and strong metals known.

Aluminum has been used in the construction of yachts in the sheathing of decks; for construction above the water line, for the purpose of allowing a greater sail area to be carried without a vessel becoming cranky or top heavy. The Defender has a total saving made in the use of aluminum of over seven tons, the hollow steel boom or gaff also saving another ton. The tensile strength was 40,000 pounds per square inch, the modulus of elasticity of the metal being 11,500,000 pounds. Aluminum is being used in our navy for air port shutters in bulkheads to prevent danger from shattered pieces of flying shells.

An important use of aluminum has just been started in parts of furniture. Bookcases, rat and vermin proof, have been made, and are welcomed by public librarians.

Pure aluminum has an electrical conductivity of 63 to 64 per cent., and Prof. Richards has stated that with absolutely pure aluminum a conductivity of 66 to 67 per cent. of pure copper would be obtained. It is practically non-magnetic and may be used for purposes where a magnetic metal would be useless. Already the Pittsburg Reduction Company have finished several hundred miles of wire for telegraphic work. The use of aluminum for field military telephone and telegraph wire has special advantages. Nickel aluminum castings have been made with a conductivity of 50 per cent. of pure sheet copper. The tensile strength of ordinary copper castings is 19,000 pounds per square inch, while nickel aluminum castings have been furnished with tensile strength of 30,000 pounds per square inch.

The purest aluminum we have been able to obtain was 99·93. The purity of the commercial article as ordinarily sold is 99·30. I feel safe in making the statement that a good deal of the metal being sold is 99·60. Of copper the purest that has been made was 99·95, and the purity of the commercial metal is 99·50.

Aluminum has played an important part in the cases for compressed food, not only allowing of rapid distribution of food, but also as convenient dishes in which to heat and cook the food at the time of consumption.

Tea boxes are being made out of thin aluminum sheet weighing about $\frac{1}{6}$ pound per square foot, with angles on the inside corners for holding the sheets together.

Generally speaking, for purposes where aluminum alloy is brought into requisition in sheet form or in the shape of angles, 32,000 to 40,000 pounds per square inch may be allowed, and gives an allowable working strain of from 8,000 to 10,000 pounds per square inch. The ultimate strength of the pure aluminum is 6,000 to 7,000 pounds per square inch.

Castings of aluminum can be taken at 16,000 pounds per square inch for pure aluminum and 24,000 pounds per square inch for alloys. The pure metal should not be used in castings, except for electrical purposes, as it is very difficult to cast; is soft, comparatively weak, and has a much larger shrinkage. Alloys of 5 to 20 per cent. with copper and other metals should be used.

The ratio of the ultimate shearing strength to the ultimate tensile strength, with double riveted joints, is 70 per cent., and for single riveted joints is about 60 per cent.

The attention of those contemplating the use of aluminum for structural purposes is called to the fact that the elastic limit is closer to the tensile strength than in most other metals. Where any great strength is desired, the metal should be protected so that the temperature is not raised very much beyond that of the ordinary atmospheric air, because it melts at a little below 1,200 degrees F. For temperatures between 100 and 200 degrees Centigrade, the unit of strain should be decreased.

In the purifying of water aluminum is destined to take an important part. Alum and the sulphate have been used considerably to purify water. The active principle of alum has been the hydrate of alumina. The idea is that the gelatinous hydrate of alumina can be better produced from metallic aluminum plates immersed in water. Should the process develop, as it bids fair to, there will be a very large increase of demand for alumina. The aluminum plates being used as anodes, with the electric current passing through their ends and effecting a decomposition of the water, ozone is produced, and the electrolytic action on the water and the action of some principle in the freshly precipitated hydrate of alumina take the impurities out of the water somewhat in the form of a scum, which has really only to be seen to show how rapidly and how well the operation can be conducted.

For the ordinary coinage, aluminum, in its harder alloys, seems to be particularly well adapted. Several countries, including the United States, India and several of South America, have started to investigate the merits of the aluminum alloys for the use mentioned.

Aluminum has been extensively used in brushes and combs. There are two companies making nothing but aluminum combs. In canteens, buttons, bell plates, rings for shoulder bands, scabbard handles and shoe pegs it is largely used. One advantage in the use of an aluminum shoe peg is that there is no corrosion as there is with an iron peg.

Aluminum has been used for burial cases or caskets of various kinds.

The soldering of aluminum is found a difficult task; most of the hard and soft solders will not stick, the heat rapidly vanishing from any of the molten solders, causing them to freeze before the joint can be made. Pure tin, with a little phosphor tin, is the basis of a majority of the solders. A special solder for aluminum has been made by Edwin M. Cook, not used with any flux, simply requiring the aluminum surfaces to be cleaned and then coated with the solder.

Many fluxes have been proposed in the soldering of aluminum. Common stearin, such as is used in wax candles, has been found as efficient as any of them. Special care should be taken to clean the surfaces to be soldered, which can be successfully accomplished by any mechanical means, thus exposing fresh metal surfaces freed from the thin film of oxide of aluminum and oxide of silicon. A good plan is dipping the sheets into nitric acid diluted with three times its bulk of hot water. The solution can be kept in leaden or glass lined tanks.

Aluminum is a very sonorous metal, and is used quite extensively for gongs in the place of brass.

The first uses to which aluminum was applied were naturally those which would stand the high cost of ten to fifteen dollars per ton. This was for opera glass tubes and other optical instruments, and it was then used in thin sheets; also used in powder made from the foil in a large line of fancy goods, where the proportion of the metal was a small proportion to the total cost.

A source of failure of the metal was applying it to aluminum apparatus for heavy liquids. It will not stand more than one hundred pounds per square inch without leaking—percolating through the pores of the metal. Better strengths will be made later on to stand these heavy liquid pressures.

The lecturer would not recommend the use of aluminum at 300 degrees F. This makes it impracticable for steam boilers where the pressure is high.

The importance of aluminum in industry is emphasized by its now supporting papers devoted specially to its development, chief among which in this country is the Aluminum World (published in New York City), while there are several such published abroad.

[Continued from SUPPLEMENT, No. 1129, page 18028.]

EDWARD DRINKER COPE, NATURALIST.*

IN 1886 he received an appointment to a chair in the University of Pennsylvania and became professor of geology and paleontology. Such a man naturally awakened the interest of apt pupils, and he was a facile and entertaining lecturer. From the stores of a rich memory he could improvise a discourse on almost any topic within the range of his varied studies. His views were so much in advance of those in any text book that for his own convenience, no less than for the benefit of his pupils, he felt compelled to prepare a "Syllabus of lectures on geology and paleontology," but only "Part III, Paleontology of the Vertebrata," was published. It appeared in 1891 and is still a valuable epitome of the classification of the vertebrates, recent as well as fossil, giving in dichotomous tables the essential characters of all the groups above families and also the names of all the families. His own industry and investigations did much to render this antiquated in even six years, and a new edition or work became necessary. "Upon the Tuesday preceding his death he sent to the press an elaborate outline of his university lectures, containing his latest ideas of the classification of the Vertebrata."†

THE LATE EDWARD DRINKER COPE.

The enormous mass of publications constantly flowing from his own pen might lead one unacquainted with the author to suppose that he was probably a recluse, but there were few men of his intellectuality who were less disposed to seclude themselves. He enjoyed and gave enjoyment to intellectual company and was a brilliant conversationalist. He was especially fond of academical meetings, and was an unusually frequent attendant at the meetings of the American Association as well as of the National Academy of Sciences. His election to the presidency of the American Association was highly esteemed by him, and doubtless his address would have been a notable one.

In February (1897) Cope's health became seriously affected by nephritic disorder, which, it is said, "might possibly have been remedied by a surgical operation," but this he would not submit to. Notwithstanding failing health, he continued active almost to the last. Finally the insidious disease invaded his entire system, and he died on the 12th of April, in the room he had long used as a study, surrounded by the objects of his lifelong attentions.

Such were the chief episodes of Cope's individual life; the facts known are few, and the record belongs rather to his family than to us. But Cope's real life was in his work, and to the consideration of that work we may now proceed. Let us adopt the order in which he took up the subjects of his investigations and successively look into his contributions to herpetology (III), ichthyology (IV), mammalogy (V) and paleontology (VI); we may then examine his philosophical views, and especially those relating to evolution (VII); finally we may attempt to forecast the position he is destined to enjoy in the history of science (VIII). To know him as he was, we must recognize his weakness as well as his strength. He himself has wished this and has asked in the spirit of the Moor:

Speak of me as I am; nothing extenuate,
Nor set down aught in malice.

III.

The extent of Cope's contributions to herpetology have been referred to. Herpetology was his first love and continued to be the favorite branch of science to his life's end. His impress on it was, in some respects at least, greater than on any other of the sciences he cultivated, and doubtless the systems he introduced, with some modifications, will be the most lasting. He found herpetology an art, he left it a science; he found it a device mainly for the naming of specimens, he left it the expression of the co-ordination of all structural features. The reformations he effected in the classification of the anurous amphibians and the saurian reptiles were especially notable.

The anurans had been chiefly differentiated in groups on account of the most superficial characters. Such were the modes of fixation of the tongue or its absence, the development of disklike expansions of the tips of the toes, or simply attenuated toes, and the presence or absence of teeth in a jaw. Cope proceeded to investigate the group in an anatomical manner and reached entirely new conclusions. He found that important differences existed in the structure of the sternum, and especially in the connection of the lateral halves. In the common toads and tree toads of Europe and North America the so-called clavicle and coracoid of each side are "connected by a longitudinal arched cartilage which overlaps that of the opposite side," while in the common frogs the clavicles and coracoids of both sides are connected by a single median cartilage. The former type is now known as the arciferous and the latter as the firmisternal. Although Cope was the first to appreciate the significance of these characters, he did not at once fully realize their morphological value, the name Arcifera having been originally applied by him only to types of that group having teeth. Ultimately he did so, and his views have stood the test of time and the latest critical investigations. He also found that the characters so revealed served to fix the places in the system of the groups in question. In their early stages the Firmisternials (or frogs and their relations) have the shoulder girdle movable, and thus resemble the Arcifera (toads, etc.), which have the opposite halves movable during their whole lifetime; thus it became evident

* Presidential address by Prof. Theodore Gill before the annual meeting of the American Association for the Advancement of Science, August 9, 1897.

† Osborn in Science, May 7, p. 706.

that the latter are the lowest or most generalized forms, and the former more advanced and higher in the system. The development of teeth, which had been supposed by the earlier systematists to be of paramount value, and which Cope, following in their footsteps, had also originally unduly valued, has been found to be of quite subordinate importance.

The lizards were also in former times distributed into families and other groups on account of variations in superficial or external characters, such as the form of the tongue, the arrangement of the scales and the development of legs and feet. Cope dissected examples of all the types he could obtain and found that such superficial characters were often misleading, and he proceeded to arrange them with reference to the preponderance of all characters. The structure of the cranium especially was analyzed, and the variations and concordances in the development of various bones were tabulated. These characters were supplemented by others derived from the vertebræ, the shoulder girdle, the teeth, the tongue and the osteodermis. Familiarity with his subject enabled him almost instinctively to assess the relative values of the different characters, and he obtained fitting equations which resulted in a system which has received the approbation of the most competent judges to the present time.

The extent of Cope's influence on herpetology may be to some extent inferred from the catalogues of the richest collection of reptiles and amphibians in existence—the British Museum's. Descriptive catalogues of both the Anurans and Saurians have been published at different times. In the early catalogues are adopted the views current at the dates of publication—1845 for the lizards; 1858 for the batrachians. New editions were published many years later, and the systems of Cope were adopted with slight modifications. In his catalogue of the Batrachia salientia, Mr. Boulenger, the author, remarked that it appeared "undeniable that the principles of classification laid down by Mr. Cope are more in accordance with the natural affinities of the genera of tailless batrachians than those employed by other authors; this is amply proved by all we know of their geographical distribution, development and physiology."

In an article* published in advance of his catalogue of the lizards, Boulenger states that the old classifications are, "on the whole, as unnatural as can be," and that, "like Cope, whose lizard families I regard as the most natural hitherto proposed, I shall lay greater stress on osteological characters and on the structure of the tongue."

It was a long time, however, before Cope's views became popular. Even anatomists of repute refused to follow him. One † of them, for example, admitted that "skeletal characters are, indeed, most valuable ones in leading us to detect the deepest and truest affinities of vertebrate animals, but [he urged] these affinities once found, it is very desirable that zoological classification should not, if it can possibly be avoided, repose upon them only, but rather on more external and more readily ascertainable characters." He therefore ventured "to propose a classification derived from that of Dr. Günther."

Cope replied * by a fierce review of the work of Dr. Günther, and concluded with the utterance that such views "will only interfere with the progress of knowledge if sincerely held and believed."

But such views were evidently sincerely believed, and they did retard the progress of science. An eminent Russian herpetologist objected to the use of anatomical characters. He especially protested against those employed by Boulenger after Cope to the grouping of the lizards, and Mr. Boulenger considered it incumbent on him to defend the practice of using such characters;† he aptly replied that the use of "purely external characters . . . does not meet the requirements of modern science," and that classifications are not made simply "for the convenience of beginners."

At last, however, the principles of classification adopted by Cope have become generally accepted, and doubtless this was in no small degree hastened by their application to all the amphibians and reptiles by Boulenger.

Cope's attention to the extinct reptiles was excited by the examination and consideration of a carboniferous lizardlike amphibian which he was requested in 1865 to report upon. It was a new species which he named Amphibamus grandiceps and considered to be the type of a new order to which the name Xenorachia was applied, but which he subsequently referred to the new comprehensive order Stegocephali.

He sought for specimens of the extinct species with as much enthusiasm as he had for the recent. Extinct and living he considered together, and light was mutually reflected from the two to guide him in the perfection of the entire system. In 1869 he gave expression to the results of his studies in a well illustrated "Synopsis of the Extinct Batrachia, Reptilia and Aves of North America." This was supplemented in 1874 by addenda and a "Catalogue of the air-breathing Vertebrata from the Coal Measures of Ohio."

A rich field was opened to him in 1877, when he received the first installment of reptilian remains from Texas, which were at first considered to be of Triassic age, but subsequently determined to be Permian.

Successive installments of amphibian as well as reptilian skeletons enriched his collection, and his investigations revealed a new and wonderful fauna rich in species and often differing widely from any previously known. These were described in many articles. The results for the amphibians were summarized in 1884 in a memoir on the "Batrachia of the Permian Period of North America."

The Permian amphibians were found to vary much in the composition of their backbones. Instead of having single centra arranged in a continuous row as in existing vertebrates, they had distinct bones on which were devolved portions of the functions fulfilled by the centra of higher vertebrates. Some had "the vertebral bodies represented by three segments each, a basal intercentrum and two lateral pleurocentra;" these were named "Ganocephali" and "Rhachitomi." Some "differ remarkably from all other Vertebrata in having between the centra another set of vertebral bodies, so that each arch has two corresponding bodies;" these were called "Embolomeri."

In tracing the development of these bones, Cope came to the conclusion that they were only partially represented in higher or more specialized types; they did not become consolidated, but one or the other became reduced and finally lost or at least greatly atrophied. In the living amphibians the vertebral centra are homologous only with the intercentra, while, on the contrary, the centra of the reptiles, birds and mammals are represented by the pleurocentra of the Rhachitomes.

(To be continued.)

* Synopsis of the families of existing Lacertilia. Ann. and Mag. Nat. Hist. (4), XIV. 117.

† Mivart in Proc. Zool. Soc., London, 1869, p. 284.

* Cope in Am. Journ. Sci. (3) L., p. 308.

† Boulenger in Ann. and Mag. Nat. Hist. (5) XIX., 385.

THE ANT EATER IN THE ZOOLOGICAL GARDEN AT STUTTGART.

The Zoological Garden at Stuttgart has for the last four years exhibited a pair of ant eaters (Myrmecophaga jubata). These are natives of South America, and belong to the family of Edentata, their jaws being quite toothless. Thanks to the great care bestowed upon them, they are in a state of splendid health, in spite of the difficulty generally experienced in keeping similar specimens long in captivity. As for breeding these animals, all attempts had proved useless until lately.

ANT BEAR AND YOUNG AT THE ZOOLOGICAL GARDENS IN STUTTGART.

But at the Stuttgart Zoological Garden, which has had similar successes before, in the way of American ostriches bred in captivity, and the pairing of a brown bear with a polar bear, there have on three occasions come into the world young ant eaters. The first comer was unexpected, and was unfortunately killed by his father. The second time they managed to keep the young animals alive for a week, and to make some observations. Once more there has been a young ant eater born, and our illustration shows him in the position he took from his birth, and kept till his untimely death—for he too was not destined to live long. He was crushed by his mother on the third day of his life.

It resembled its mother in shape and color, only the fur was shorter and softer. The claws on the forefeet, the ant eater's only weapon, were already well developed, enabling the animal to climb up on its mother's back without the least difficulty. It never left that place except when the mother lay down.

Further breeding on the part of the ant eaters at Stuttgart seems within the range of possibility.

Our illustration is taken from Illustrirte Zeitung.

The use of street cars, omnibus and city railroad lines in Berlin, Germany, has considerably increased from 1895 to 1896. In 1895 some 270,000,000 odd persons were carried by the various cars; 1896 the number rose to 311,200,000 persons, the increase being over 41,000,000. The average daily total of persons using the street cars and omnibuses in 1895 was 739,862; in 1896, 850,323 persons, an increase per day of 110,461 persons.—Glaser's Annalen.

THE SCIENCE OF HUMANITY.

By W J McGee.*

OF THE EXCELLENCE OF HUMANITY.

Humanity is a favorite theme of poet and philosopher, novelist and historian, dramatist and moralist. The changes rung on the theme run the entire gamut of human feeling and thinking; its burden is caught in song and story and crystallized in books; and no sweeter strains have ever been sung, no grander scenes enacted, no nobler lines penned, than those fertilized by the touch of human (and solely human) nature that makes the whole world kin.

The chief subject of thought among all races is humanity in some of its numberless aspects; the chief part of the literature of civilized nations relates to humanity; the chief activities of all men are inspired by humanity. Yet—and this is a modern marvel—for the greater part the thought is vague, the literature chaotic, the activity unorganized; i. e., this most important of all subjects-matter and objects-matter in human ken has hardly been brought into the domain of that definite knowledge called science. It is meet to inquire why this is so; and, to the end that the inquiry may be answered clearly, it is needful first to define humanity and then to consider what knowledge is and the way in which science has come to be; later the half formed science of that which is proper to intellectual man and most important to his kind may be outlined.

OF THE PURPORT OF HUMANITY.

According to the lexicographer, humanity denotes (1) the condition or quality of being human, (2) the character of being humane, (3) the character of being well bred, (4) mankind collectively, and (5) secular learning or literature.† The fourth of these definitions connotes man—the genus Homo, object-matter of the broad science of anthropology—viewed in a distinct way, i. e., as a mass or composite body rather than discrete individuals. The fifth definition connotes but a limited field in a vast domain, and is scholastic if not archaic; with this sense the term is chiefly used in opposition to divinity, often in the plural form (though there is good precedent for the use of this plural form in a more general and at the same time a more definite sense).‡ The first three definitions connote a wide range of attributes of man which, albeit well recognized by all intelligent people, are rarely reckoned among the objects-matter of anthropology, seldom included within the pale of science; yet it is these attributes that especially distinguish man and set him apart from the mineral, vegetable and animal worlds, and exalt him above the rocks and plants and beasts of simple nature.

Although commonplace, these definitions are worthy of careful consideration in that they summarize the substance of intelligent thought since the beginning of writing—indeed since its own beginning in the remote unwritten past—and particularly during the era of unprecedented intellectual activity and scientific progress dating from the issue of Bacon's Novum Organum; they carry the wisdom of the ages, and especially of these later days during which wisdom prevails as never before. Viewed separately or in connection with contemporary definitions relating to mankind, they indicate general (albeit vague) recognition of certain specific attributes of man, not as an animal but as an ill defined something known as a human being. When the history of thought condensed into the set phrases of the lexicographer is scanned, it is found that bitter controversy has been engendered by the diverse aspects of man as seen from opposite sides; the disputants, like the storied knights of old, have admired the object, one as silver and the other as gold, and have done doughty battle in defense of their one sided vision. The biologist, with eyes trained by observation and reason sharpened by long study of living things, sees the silvern side and sounds trumpet for man as an animal, while the litterateur and statesman and philanthropist are half dazzled by the golden glory of man as a thing supernal. The fair conclusion is that both are right as to what they see and both wrong as to what they fail to see; and in the light of this conclusion it is clear, if the general judgment of the body of thinkers is worth anything, that man has an animal basis on which a noble superstructure is borne.

The definitions of the lexicographer, who voices the thought of the world, show that among general thinkers the idea of humanity prevails over the idea of animality, while the current literature of science indicates that the idea of animality is dominant in scientific circles; indeed, some writers on anthropology, the science of man, restrict the term to knowledge of the mammalian order Bimana, a limitation excluding the essential characteristics of man as a thoughtful and emotional being and as an integral part of a collective and interdependent assemblage. Any attempt to harmonize these opposing ideas must begin with definite statement of the meaning attached to the essential term by more catholic anthropologists. So humanity may be defined, by exclusion, as the condition or quality or character of possessing attributes distinct from those of animals, vegetals, and minerals; or, by inclusion, as (1) attributes or characteristics confined to human beings, comprising (a) the condition or quality of being human, i. e., of acting, feeling and thinking after the manner of human beings, (b) the character of being humane, and (c) the character of being well bred; (2) mankind collectively; (3) learning and literature.

The supreme importance of humanity as thus defined is indicated by the fact that it is the foremost subject-matter of thought and speech and literature among all people, its prominence increasing from savagery through barbarism and civilization and culminating in enlightenment. The essential distinctness of humanity as thus defined appears when its serial relations to the other primary objects-matter of knowledge are considered. Just as living things rise above the mineral world by the possession of vitality, and just as animals rise above plants by the possession of motility, so do human beings rise above all other things by the possession of specific attributes rooting in mentality and maturing in the complex activities of collective life; or just as inorganic matter is the basis for the essentially distinct organic existence, so organic matter and processes form the basis for the essentially distinct superorganic activities of human existence. The importance and distinctness of humanity are indeed such that it behooves naturalists to recognize a fourth realm or world; to extend science from the great realms of the mineral, the vegetal, and the animal into the incomparably broader and richer realm of the purely human; and this extension is the chief end of modern anthropology.

OF THE QUALITY OF KNOWLEDGE.

Human knowledge is constantly increasing. The body or aggregate of knowledge is imponderable, and may not be counted or measured or weighed; yet it is an entity of prime importance and of universal recognition. Itself indefinite and varying from mind to mind, the sum of knowledge may be divided, albeit roughly, and analyzed, albeit crudely, and the days and years and centuries of its progress among men and peoples may be so studied that its tendencies and perhaps even the laws of its growth may be followed, albeit slowly and uncertainly. Although so indefinite, it is well worth while to try, and try again and still again, to analyze knowledge and trace its progress; for knowledge is the end and aim of intelligence, and human progress is measured not more by increase in knowledge of things than by increase in knowledge of knowledge.

Many students have found it convenient to divide or classify knowledge as individual and common, general and special, empiric and scientific, deductive and inductive, etc., according to the point of view; and these divisions are of use in that they represent first steps in analysis, though it is to be remembered that they are more or less vague or arbitrary, one or both. It may not be bootless slightly to extend this provisional analysis in order to trace more clearly the lines and stages in the growth of intellectual product.

For the sake of gaining clear ideas of relation, it is sometimes useful to project perception by the aid of mental imagery, and thereby to visualize the invisible in the eye of the mind. So the great aggregate of knowledge is often likened unto a numerical sum, or a reservoir or river fed by many affluents; but a better figure may be found in scientific ideation, and the imponderable body may be pictured as an indefinite nebula or plasma, constantly growing by accretion and constantly undergoing internal change. This plasma may best be portrayed as for the most part unorganized, with partially or completely organized nuclei and nodes and processes here and there; and there is a certain fitness in conceiving the organized tracts as near the surface, where the interactions between external and internal are direct and continuous. In this way the intellectual product of the world may be likened unto a nebula, a cloud gathering in a supersaturated solution, an ameba, or a brain—it may be viewed as a chaos more or less advanced on the way toward cosmos. The image is ideal; it serves merely as an aid in grasping and formulating widespread notions concerning knowledge as an illusive and intangible yet vigorously real and important something; but it is not essential to correct understanding of the main facts in the growth of knowledge.

Knowledge is born of the individual brain fertilized by indirect contact with other brains, and is given unto others with a degree of freedom varying with the disposition of the individual and the perfection of his mechanism for conveying thought—gesture, picture, speech, writing, printing, the growth of knowledge keeps even pace with the acquisition of structures and devices for its expression; and it is a pleasant and significant fact that in general the disposition to dispense knowledge grows strong and active just as the dispensing mechanism improves, though usually lagging a little behind—much as the verdure follows the vernal shower. So the stage of individual knowledge is initial, the stage of common knowledge consequent; so, also, individual knowledge is barren and unproductive until turned into the general fund to increase and multiply a hundredfold; and so, too, there is progressive growth from the initial stage of individual discovery or invention, through many ill-defined yet successively higher and higher steps, well toward the mature stage of general possession. It is needful to observe that the body of general knowledge can never quite equal the aggregate knowledge possessed by individuals; although stimulated by others, each active individual knows something more than he is able to tell, be he never so free in disposition and facile in expression; and it is the never-ending process of coining and issuing and exchanging the precious product of the cerebral crucible that gives rise to intellectual property right, and at the same time enriches the great plasma of knowledge and maintains the activity essential to its existence. It follows—and this scientific certitude may be commended to a certain class of socialistic schemers—that the relation between individual knowledge and general knowledge is asymptotic, and that although the latter constantly approaches, it never can reach the former; indeed, if general knowledge were ever to overtake individual knowledge, through suspension of the laws of intellectuality (undoubtedly immutable as those of vitality), the special province of mental activity would be annihilated and the body of knowledge would sink into quiescence—and, in the intellectual as in the vital, quiescence is death.

As knowledge is produced and given unto others the freedom of giving is governed by numberless conditions, including the perfection or imperfection of the mechanism for expression, the avidity or indifference of the chosen beneficiaries, and the price fixed by custom, and so it happens that certain discoveries and inventions are directly communicated only to limited groups of individuals, who thereby accumulate special knowledge. In this way cliques and trades and guilds arise and the germ of caste is planted. In this way too specialists grow up through the indifference of the masses and their inability to keep pace with the investigator whose energies are directed along a single line; and eventually, among the most enlightened peoples, special societies are formed for the purpose of fostering or diffusing discovery and invention, and thereby rounding out the great plasma of human knowledge. It may be noted that special knowledge is nearly as barren and unproductive as individual knowledge, and is soon blasted by the poison of its own egoism, unless the richer part of its substance is guided toward the general mass—to do work as it advances; for it is by no means to be forgotten that the activity of the great body of knowledge culminates in the province or zone of special knowledge, and that herein lies the leaven that leavens the whole.

During recent centuries, and especially during recent decades, specialists engaged in creating knowledge have studied knowledge itself, in the hope of learning its nature and origin; and most of these students have become convinced that the basis of real knowledge is found in the facts of the cosmos as revealed by observation or established by experimentation. So the acquisition of knowledge begins with noting particular facts and advances to assembling or grouping these facts, i. e., proceeds from observation to generalization; the second process involves the elimination of the unlike or incongruous, and this leads to discrimination and to the recognition of analogies. In general terms and somewhat provisionally it may be said that the analogies so recognized constitute laws of occurrence which may themselves be generalized, and that the requisite discrimination of analogies leads to the recognition of homologies, or laws of occurrence and sequence combined; the framing of analogies and homologies being legitimate inference, which develops in hypothesis and matures in theory or doctrine to be finally formulated in laws or principles. Knowledge produced in this regular and simple manner is commonly called inductive, though there is always a deductive element coming over from that general intellectual possession by which even the closest specialist is guided in greater or less measure. Now it is to be noted that acquisition of knowledge is largely spontaneous and unconscious—that apperception lags far behind perception, and that only the adolescent and mature among men and peoples are clearly conscious of their own mental processes, or indeed of the existence of mental process; it follows that most of the processes just outlined are ill recognized or not recognized at all, even by the very makers of knowledge. Moreover, the later steps in intellectual acquisition are commonly the first to be consciously noted; so that the majority of men, even unto the present day, have failed to recognize the true source of real knowledge, and have appealed to all manner of mysterious and extravagant sources for part or all of the intellectual wealth of the world; for, while the more complex processes alone were recognized, inference was exalted and observation was contemned, subtile imagining ran riot and overshadowed sober reason, and scholastic learning—which the practical makers of progress fortunately ignored or repudiated—grew into a labyrinth of deductions from vain postulates and hazy lucubrations. A new epoch dawned when Bacon formulated the inductive method—though he knew not that the method was old as the human mind and that he but recognized that which all men do, whether consciously or unconsciously. Reviewing the course of intellectual acquisition from observation through generalization and inference and theory unto laws of occurrence and sequence, knowledge may be classified by degree of development, and the simpler and more primitive (whether burdened by assumption or not) may be called empiric, while the more definitely organized product of special study may be called scientific; and remembering that the processes of acquiring knowledge are partly unconscious, that portion which is organized unconsciously may be classed as common sense or the wisdom of experience, while the consciously organized portion may be called science. This summary of the mode of organizing knowledge may be trite, yet it serves to show that the methods of the student of humanity are in nowise different from those pursued in the physical and natural sciences.

In brief, knowledge is ever passing from the individual to the common and from the special to the general, and thereby its quantity is constantly increased and its utility extended; during recent times it is passing also from the empiric to the scientific, and thereby its quality is improved and its beneficence multiplied.

OF THE RISE OF SCIENCE.

When the history of the class of knowledge called science is scanned, certain tendencies or directions of growth are perceived; and scrutiny shows that these tendencies are in harmony with the course of development of knowledge in general.

1. In general, observation and research begin with the rare or remote and proceed toward the common and the near. This tendency is revealed when the several branches of science are compared. Perhaps the oldest science is mathematics, which began before history, so that its origin is obscure and cannot certainly be traced to definite objective basis; but the nearly contemporary and closely related science of astronomy rested on observation of the celestial bodies—though the observation was long clouded by the mysticism of astrology. Then, as wits were sharpened by mathematical research and astronomical observation, exact knowledge was gradually brought down to nearer bodies and under the guidance of everyday observation; and thus the science of physics arose so gradually and inconspicuously that its early history is lost. Later shrewd hermits and beldams wrought magic by means of rare substances, and alchemy grew up; and as time passed the manipulations were extended to common things and the ban of secrecy was gradually broken, and so chemistry arose. These four branches of knowledge concerning the inorganic interacted with mutual benefit, and for several centuries constituted science, in contradistinction from the vast body of vague thought comprised in scholasticism and folklore and from the more useful body of commonplace knowledge not yet consciously organized. Still later attention was attracted by things nearer to mankind in place and character, and first plants and afterward animals were studied systematically, and botany and zoology arose; but for a long time the most attractive organisms were the unusual and therefore striking, or the specimens brought by travelers from distant lands—indeed, even during the present half century, scientific museum administrators are embarrassed by the tendency of the collector to neglect the common and collect the unusual in his own locality, and it is only within a generation or two that the ordinary plants and animals supplying mankind with food and clothing and other everyday

* Vice-presidential address before Section H of the American Association for the Advancement of Science, delivered at Detroit, August 9, 1897.

† Condensed and rearranged from the Standard and Century Dictionaries.

‡ E. g., in "The Humanities," by J. W. Powell; Science, new series, vol. 1, 1895, pp. 15-18.

commodities have been subjected to scientific research. In like manner the science of geology began, soon after botany and zoology, with the study of rare minerals and the ancient rocks of remote mountains; gradually the research extended to the nearer hills and valleys and the later formations; and it is only within the present generation that the soil-making deposits on which human life so largely depends have been brought under scientific examination. Last of all the scientific research beginning with the stars and passing to minerals and plants and animals, and through the soil on which plants and animals live, reached man himself; yet the studied observation began not so much with fellow citizens or fellow subjects bound to the student by ties of consanguinity and affinity as with the abject savage or half clad barbarian of distant lands; and even to-day, and in the most enlightened nations of the earth, the pictures brought up in most minds by the term anthropology are those of alien and inferior peoples, or of human curiosities and monstrosities exhibited in midway plaisances if not in circuses and dime museums. Even in scientific circles—yea, among those ranked as anthropologists—there are many who habitually restrict the term to the purely animal side of man, and ignore that broader and nobler side which distinguishes mankind from all other things. So, whether science be viewed in general or in detail, it is found that its progress is toward the Ego—toward the everyday and commonplace perhaps, yet ever toward the more important because the nearer, the more useful because the commoner; and the more nearly it approaches, the more clearly it is seen that science dignifies both student and object of study—that exact knowledge, with Midas touch, turns dross to gold.

2. In general, research begins with the abnormal and proceeds toward the normal. Judging from the habits of present day barbarians, among whom the tempest is studied and the zephyr ignored, the comet remembered and the planet forgotten, the pre-Chaldean astronomers based their first celestial observations on the erratic wanderers, rather than the orderly travelers of the sky; and in all ages prodigies—the bizarre and ill formed, the gigantic and dwarfish—have been the first to catch and the longest to hold attention among casual observers and specialists alike. This tendency toward noting the abnormal, like that of regarding the rare rather than the common, is the easily besetting sin of the touring naturalist and local museum collector, the joy of the unscientific and the despair of the scientific among museum administrators. Clearly seen in geology and zoology and botany as the vestige of a primitive past, this tendency to perceive only the abnormal is still strong—indeed, almost dominant—in the younger science of anthropology. To-day, distorted or wounded or cachectic skulls from the ancient ossuaries of Africa or the huacals of Peru are esteemed far above normal crania of a normal people who have, by normal activities, aided in making civilization and ennobling the world. To-day the platycnemic tibia and perforated humerus of questionable significance are exalted above the normal members occupied in the march of progress and the conquest of lower nature. To-day there are a flourishing sub-science called criminology and a fantastic fad of extolling and magnifying degeneracy, while the upright in mind and the sound in body are relatively neglected; yet this apparently morbid taste but reflects a tendency of the human mind, and is the promise of better things when the intellect, awakened by the abnormal, acquires the power of appreciating the normal.

Unremembered millenniums of mystical shamanism were required to produce pathology and therapeutics, and centuries of pathology were needed to produce sound physiology and etiology, and in like manner there were generations of mystical and irrational psychomancy before students were able to recognize a basis for the modern and most promising science of psychology. It smacks of the paradox to say that the beginning with the abnormal is the normal course in the making of science; yet the history of each and all of the sciences shows that the observation on the abnormal has always led attention to the normal, just as observation on the remote has ever guided attention toward the near; and it is but natural that the youngest of the sciences should yet retain vestiges of undue magnification of the abnormal.

3. In general, scientific determination proceeds from the qualitative to the quantitative. This tendency is displayed by every branch of science, and so conspicuously that it may be deemed characteristic. It is in accordance with this tendency that estimate precedes weighing and reconnaissance goes before surveying; and it is under the same tendency that scientific progress involves constantly increasing refinement in observation and ever-growing accuracy in definition.

4. In general, scientific interpretation proceeds from the formal to the physical,* from the material or the inert or the static to the dynamic. The positions and movements of the moon and planets were determined with fair accuracy before Newton discovered that the paths of these and all other celestial bodies are fixed by gravity; when this discovery afforded the means for determining position and movement with incomparably greater accuracy. The physical and chemical effects of heat were recognized for generations, and were ascribed to the hypothetic element phlogiston or the imaginary fluid caloric, long before Joule and others found it to be merely a manifestation of molecular motion; whereupon physics and chemistry were revolutionized and the forces of nature were gradually harnessed many times more effectively than before.

The ancients recognized vitality and ascribed it usually to a material something joined to the matter of the body. Some twenty four centuries ago, sagacious Heraclitus conceived life as a universal fire; and less than five centuries ago Paracelsus, and after him Van Helmont, wrote of the anima mundi or archeus, having in mind a vaguely imponderable thing akin to the so-called astral body which votaries of an Oriental belief imagine themselves able to materialize out of the depths of transcendental reverie. Two centuries ago Hoffmann and other anatomists spoke habitually of the vital fluid as contemporary physicists of phlogiston, and within a hundred years leading physiologists, like Hunter, thought and wrote of the "diffused vital material." Less than a quarter of a century ago, Barker

* As defined by Le Conte in a notable article "On the Structure and Origin of Mountains," American Journal of Science, third series, vol. xvi, 1878, page 107.

was deemed bold unto recklessness for undertaking to correlate vital and physical forces,* and many heads were shaken doubtfully when, in his presidential address before the American Association, at Boston, in 1880, the same brilliant experimentalist argued from the applications of Mosso's plethysmograph that mental force also may be weighed and measured, so that it must be regarded as interconvertible with other forms of energy;† yet half a generation of organic chemistry and physics has established these revolutionary propositions beyond peradventure, and introduced a new area of biologic research.

The tendency toward dynamic interpretation is well shown, too, in geology. In the infancy of the science, formations and the extinction of faunas were ascribed to extra-natural cataclysms, the opening of valleys and the shaping of hills to ill conceived or inconceivable catastrophies. With Lyell—a personal associate of scientific men now living—came the doctrine of uniformism, under which it is recognized that existing rains and rivers and silt-distributing waves are competent to produce the land forms and formations of the earth, provided time enough be allowed them. The present generation of geologists, beginning with Powell and including twoscore others, have scanned the pages of the Great Stone Book, so well laid open by Colorado and other rivers, and have learned to read earth history from land forms as well as formations, and have shown that at least a portion of those earth crust movements which were sheer mystery to Lyell result from the slow transfer of rock matter by the action of running water. As interpretation grew definite and the mystery of earth making dissolved, the classification gradually changed from chiefly material or static to chiefly dynamic. For a time the formations were classified by the processes of accumulation; and now the foremost geologists classify earth science primarily by the great agencies of earth making.

In anthropology, interpretation has not yet grown definite, and there are nearly as many modes of interpreting as there are men to interpret; yet, even in the short and complex history of this youngest of the sciences the general tendency appears; for the earlier classifications were based on bodily or somatic features, while the more advanced among current classifications rest either on collective attributes or on the activities of the human groups; i. e., the older classifications indicate what men are, the newer indicate what men do. Only half a generation past was it definitively suggested that human mentality is a form of energy, but already the testimony of the plethysmograph has been corroborated in so many ways and so widely extended that most scientific students of mental phenomena assume, either explicitly or implicitly, the essentially physical character of intellectual action; and in this writing it is assumed that intellectual energy is paramount, in that it is able to control other forms of energy and make conquest of nature through invention and construction, and the faculties and works of man are classified and interpreted accordingly.

So in astronomy and physics and chemistry, and equally in biology and geology, the progress of science may be measured by the ever increasing recognition of the dynamic aspect of phenomena, of the physical forces by which the material things are moved; with the recognition of inherent energy or motion, observation progresses from the merely qualitative to the quantitative, and constantly increases in refinement; and in view of this progress in other sciences, it can hardly be regarded as premature to attempt the extension of quantitative measure and dynamic interpretation to that side of anthropology which deals with the purely human attributes.

5. In general, scientific interpretation progresses from the stationary to the sequential; for the idea of action engenders the idea of succession. The Chaldean shepherd, the Egyptian soothsayer, and the Peruvian priest, like the earlier oriental astrologer, probably first took note of the celestial bodies as striking features of the cosmos, and later observed their rhythmic procession with such care that cycles were established and eclipses and other prodigies were foretold long before the true structure of the solar system was understood. These ancient observations and interpretations must have implanted that idea of the uniformity of nature which has borne so splendid fruit during the present century; the budding notion found poetic expression in pleasing fancies of firmaments of crystal and the music of the spheres; yet it was not until the germinal idea was fertilized by the Newtonian law that the marvelous measure of celestial rhythm came to be known. Led by the planless experiments of daily toil, the mechanic—forerunner of the physicist—was the next to lay hold on the notion of uniform succession; it grew with the centuries and spread into the neighboring domain of chemistry, where it vitalized the dynamic interpretation of chemic union, and aided in producing Avogadro's law, which, according to Cooke, "holds the same place in chemistry that the law of gravitation does in astronomy"‡ and forms the basis of what has justly been called the new chemistry. This law, like all others in science, afforded a means of prevision, or of presaging the unknown in terms of the known, and thus of testing its own validity; and as test followed test the idea of orderly succession grew until, with the aid of refined observation and the guidance of special experiment, it matured in the doctrine of the persistence of motion, the keynote of modern science. Here was a vantage point from which the astronomer was enabled to study the celestial bodies, especially our own sun, not merely as masses, but as chemical and physical assemblages; and so arose the line of research sometimes called celestial physics, but defined and dignified by Langley as the new astronomy,§ which has already afforded a means of analyzing the constituents and measuring the movements of several among the myriads of other suns than ours. True, each of these strides in the advance of physical science represents progressive appreciation of cosmical forces; yet still more fully do they represent progress in recognizing orderly sequence and causal succession in the movements of molar and molecular bodies.

* "The Correlation of Vital and Physical Forces."—University Series, No. 2 (Van Nostrand), 1875.

† Proceedings of the American Association for the Advancement of Science. Vol. xxix, 1881, page 19 et sequentia.

‡ "The New Chemistry" (International Scientific Series, vi.), 1875, p. 13.

§ "The New Astronomy," 1888, chapter I.

Borrowing from physical science trenchant ideas concerning force and succession, even the earlier biologists analyzed the mechanism of living things and slowly stripped away the primitive panoply of mystery or divinity in which the infantile imagination, whether of men or races, has always enveiled vitality. Lamarck was one of the first to extend the idea of orderly succession to organisms, and although his special hypothesis of development has fallen into abeyance it has features which anthropologists do well to remember; then came patient Darwin and doughty Huxley and studious Spencer with the definite doctrine of organic evolution, which spread from man to man and from land to land, producing the greatest and quickest intellectual revolution in the history of the world. Albeit revolutionary, the Darwinian doctrine was but the biotic complement of the physical doctrine of the persistence of motion, and the two doctrines are twin buttresses on which the symmetric structure of modern science is supported. Through the later doctrine the world and the things thereof were transfigured in a new beauty and perfection, the universe was invested with a new glory, and the narrow notion of breaks in the uniform course of nature by special fiat lost hold on the scientific mind forever.

It chanced that while the ferment of evolution was still fresh, a trio of American geologists—Powell, followed by Gilbert and Dutton—entered the inspiring region traversed by Colorado canyon, and before their work was done the germ of geomorphy, or the new geology, was planted. It was realized more clearly than ever before that the hills are not everlasting but everchanging, and that the features of every landscape tell an eloquent tale of continental evolution in which competent cause and commensurate effect follow ever in ceaseless succession through the eons of earth making. The task of the geologist is not ended, indeed, is only well begun; yet here, as in other sciences, the reign of law is realized, and the day of appeal to chance is past.

When Huxley sought "Man's Place in Nature,"* and still more when Darwin traced "The Descent of Man,"† the fruitful idea of the uniformity of nature was pushed into the domain of anthropology, and has now guided for a generation those branches of the science which deal with the animal side of man; it is true that the rhythmic sequence of cause and effect has hardly been extended so far as to cover the delicate and elusive attributes of humanity, but this extension is the motive of many investigators, the aim of the present writing. Already the broad realm of humanity is fairly defined, and the distinctive form of developmental succession proper to this realm is fairly outlined, so that the distinctness of the science of human attributes has been made clear; for while stellar and molecular and organic development are evolutionary in that the main tendency of change is toward differentiation, the development of humanity is involutionary, in that the main tendencies are toward integration and combination. Conformably to the fundamental facts of the great realms of nature, the earlier sciences are largely, perhaps chiefly, analytic, while the science of humanity is largely, perhaps chiefly, synthetic, and its votaries seem to find reason for figuring it as the central dome crowning and conjoining the separate columns in the ideal pantheon of science. If the confidence of the votaries is just, the youngest of the sciences may be expected to repay with interest all that it received from the several branches of knowledge whence it sprang. Already, indeed, it has thrown light on the course of organic development through researches on the human body, and has begun to guide the acquisition of knowledge through researches on the human brain and its functions; already it is contributing to the physical sciences, e. g., through the refreshing Powellian doctrine of conservation, or of common persistence of motion and matter in the ultimate particle, whereby ideas concerning the mechanism of the universe would seem to be immeasurably simplified and extended; and there are other ways in which the youngest science is daily contributing to the stock of definite knowledge. Their name is legion.

So it is that science has always progressed from the rare to the common, from the remote to the near, from the abnormal to the normal, from the merely qualitative to the quantitative, from the merely material aspect to the physical aspect, from the primitive faith in fixity to living realization of causal succession. At first sight this progress may seem puzzling, even paradoxical, yet the general course is but an expression of the order of intellectual operations pursued in scientific research. The first step is observation; it is easy when the objects observed are isolated or distinct, and increasingly difficult as the objects increase in number and similarity. The second step is generalization, which is relatively easy when the objects examined are few, relatively difficult when they are many; while the ancillary process of discrimination of the incongruous likewise grows laborious with the multiplication of objects and similarities. Accordingly it is easy to study the rare, the remote and the abnormal, and as faculty is strengthened by exercise, gradually it becomes easy to progress toward the common, the near and the normal. So also qualitative determination is easy, quantitative determination difficult—indeed, exact quantitative work is impossible without careful training, as numberless surveyors and teachers can testify. In like manner interpretation in terms of the material, coupled with appeal to the supernatural when obstacles are encountered, is relatively easy and characteristic of the indolent or immature mind, while the firm grasp of analogy and homology, and the clear recognition of energy and sequence, require both native capacity and systematic training. Accordingly scientific interpretation in terms of action and succession is the end of mental effort, and may be regarded as the highest expression of intellectuality. This correspondence between the method of research and the history of science throughout the centuries amply attests the excellence of the method. Yet it is not to be forgotten that just as intellectual grasp strengthens so interpretation is simplified, partly through the elimination of that question-begging mysticism which pervades all primitive philosophies, partly through clearer arrangement of facts and relations. And as

* First publication in 1863.

† The first edition of this notable work appeared in 1871.

interpretation grows simple three especially noteworthy effects follow: (1.) Each step in interpretation makes the later steps easier. (2.) As the labor lightens, more energy is left for the next task, and the mind of the student pushes into new fields of study and from time to time organizes new branches of inquiry; and (3.) With each extension of inquiry mental faculty is stimulated and strengthened. These tendencies are clearly indicated by the birth and growth of new sciences recorded in the history of research; beginning with the celestial bodies, it has extended to mechanical bodies, vegetals, animals, the earth itself, then to the human body, individual and collective; and now it is reaching out toward the special attributes of mankind, the things nearest to human welfare and happiness.

(To be continued.)

SELECTED FORMULÆ.

Depilatory.—

(1.) Sodium sulphydrate	100 grains.	
Slaked lime	80	"
Starch	30	"
Lime water	4 fl. dr.	

With the aid of water this powder is converted into a soft paste, and applied to a hairy skin in a layer as thick as a straw. After drying about ten minutes, the pellicle is scraped off with a paper knife, or similar blunt instrument, and with it the hair. The face should be washed clean and anointed with some bland oil.

Sodium sulphydrate is prepared by supersaturating at ordinary temperature a solution of sodium hydrate of specific gravity 1·35 (made from 1 av. ounce of caustic soda and 3 fluid ounces of water), and then setting aside the well closed jar for several days in a cold, dark place, when the crystals formed may be removed and preserved in a well closed vial, protected from the light.

(2.) Orpiment	1 part.	
Slaked lime	5	"
Starch	8	"
(3.) Quicklime	120 grains.	
Sodium sulphide	240	"
Starch	80	"
Orris root, powder	40	"

Rub the necessary portion of this powder into a thin paste with water, and apply as directed for No. 1. —Pharmaceutical Era.

Cholera and Diarrhea Remedies.—We give below a number of desirable formulas from which you may select one or more to suit your needs:

SUN CHOLERA MIXTURE.

Tincture of opium	1 part.	
Tincture capsicum	1	"
Tincture rhubarb	1	"
Spirit camphor	1	"
Spirit peppermint	1	"

SQUIBB'S DIARRHEA MIXTURE.

Tincture opium	40 parts.	
Tincture capsicum	40	"
Spirit camphor	40	"
Chloroform	15	"
Alcohol	65	"

AROMATIC RHUBARB.

Cinnamon, ground	8 parts.	
Rhubarb	8	"
Calumba	4	"
Saffron	1	"
Powdered opium	2	"
Oil peppermint	5	"
Alcohol	q. s. ad 100	"

Macerate the ground drugs with 75 parts alcohol in a closely covered percolator for several days, then allow percolation to proceed, using sufficient alcohol to obtain 95 parts of percolate. In percolate dissolve the oil of peppermint.

RHUBARB AND CAMPHOR.

Tincture capsicum	2 ounces.	
Tincture opium	3	"
Tincture camphor	3	"
Tincture catechu	4	"
Tincture rhubarb	4	"
Spirit peppermint	4	"

BLACKBERRY CORDIAL.

Blackberry juice	1875 c. c.	
Cinnamon, ground	100 grms.	
Cloves, ground	25	"
Nutmeg, ground	25	"
Diluted alcohol	q. s.	
Sirup	1875 c. c.	

Percolate the ground drug with diluted alcohol to obtain 1,250 c. c. of tincture, and to this add the blackberry juice; then add 30 grm. purified talcum, set the mixture aside for 24 hours, and filter. Wash the filter with sufficient diluted alcohol to obtain 3,125 c. c. of filtrate and add the sirup.

BLACKBERRY MIXTURE.

Fluid extract blackberry root	2 pints.	
Fluid ginger, soluble	5 1-3 ounces.	
Fluid catechu	5 1-3	"
Fluid opium for tincture	160 minims.	
Brandy	8 ounces.	
Sugar	4 pounds.	
Essence cloves	256 minims.	
Essence cinnamon	256	"
Chloroform	128	"
Alcohol (25 per cent.)	q. s. ad 1 gallon.	

—Pharmaceutical Era.

Wild Cherry Phosphate.—

Simple sirup	5 pints.	
Fine sherry wine	2	"
Depurated German cherry juice	10 ounces.	
Fluid extract wild cherry	3	"
Solution of phosphates	2	"
Fruit acid	1	"

Mix well together and filter.

For dispensing, draw a tumbler seven-eighths full with soda water; then add two ounces of this sirup, stir with spoon and serve.—Practical Druggist.

THE

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THE TRIAL OF THE MARCONI TELEGRAPH AT SPEZIA.

TELEGRAPHY without wires is still the all-absorbing topic of the day, and, therefore, although we have already published considerable about Marconi and his work, we feel sure that our readers will be interested in the accompanying engravings, one of which is a portrait of Marconi, while the other shows him as he appeared when receiving messages during his experiments at Spezia, the receiving apparatus being on a moving boat. He was assisted at this time by the electricians Civita and Pasqualini, whose portraits we also have in this engraving.

These experiments, which lasted three days, July 11, 12 and 13, were conducted on a large scale by order of the naval department, so that the full scope of the invention might be understood. On the 11th the experiments were made between the San Bartolomeo Arsenal and the offices of the department, a distance of about two and one-half miles; on the 12th the experiments were public; and on the 13th messages were sent from one moving vessel to another, care being taken to have obstacles between the vessels, as it was desired to prove beyond a doubt that no obstructions of any kind would interrupt communication. L'Illustrazione Italiana publishes the following report of the trials made on the 12th:

"The experiments took place at the arsenal at Spezia; Marconi and the electrician Civita remaining at the receiver, which was placed near the entrance of the headquarters, while Prof. Pasqualini, of the department of electricity and war supplies, stood by the transmitter, outside of the directors' room at the arsenal. Before beginning the experiments Civita explained the apparatus. The results were splendid, as they always are. Various phrases were transmitted, such as 'Evviva Marconi,' 'Evviva Bologna.' (The latter is the native city of the young inventor.) Several officers of the navy, the engineer corps and the artillery addressed questions to Marconi, who answered them all, although tired from the excitement and work of several consecutive days. Admiral Grillo presided, assisted by the commander of the Spanish vessel Cristobal Colon."

SIGNOR MARCONI.

In speaking of his own work, Marconi says:

"The greatest distance to which we have been able to transmit messages by telegraph without wires is twelve miles. But that by no means is the limit of the instrument; it simply signifies that existing appliances are not perfect. At Spezia I sent messages without wires from the San Bartolomeo arsenal to the war ship San Martino, twelve miles out in the harbor, without difficulty and with absolute accuracy. It was done before the royal commission. Official experiments will be renewed when I return to Italy in September. I have successfully experimented also at the Italian Ministry of Marine and at the Quirinal before the King and Queen. I made the discovery almost by accident. I had been studying electrical phenomena three years, when two years ago I found that by putting Hertz's radiator to the earth, connecting it with a wire extended vertically in the air and repeating the process with the modified Branley receiver, a current could be transmitted about one hundred yards without connecting the wires. Then I found that, without increasing the battery power but by simply increasing the height of the vertical wire, the influence of the instrument extended over a distance increasing in geometrical ratio to the increased height of the wire.

"The wire must extend into the air. A coiled wire helps only as the coil is high, not according to the length of wire in the coil. A wire inclined instead of vertical has power equal only to that developed by a vertical wire as much shorter as the distance taken up by the inclination. A wire carried to the top of the high mast of a ship ought to enable the captain to telegraph a considerable distance, figuring that 100 feet in height of the wire means twelve miles in distance of communication. By the same process magazines could be exploded in time of war from a great distance, and signals could be sent so that the enemy could not possibly interrupt communication. It has been said that this would work both ways, that a current radiates in all directions from the sending instrument and, therefore, that a message would go to the enemy's camp as well as to a friend's. But this can be easily prevented, as I have proved, by means of electrical reflectors, which would arrest the progress of a message in all directions but one. I am not certain that I shall ever be able to send messages across the Atlantic, but I can see no reason why I should not do so, if I can increase the height of a vertical wire enough. I am just as much in doubt as you are as to the reason for this strange influence of a vertical wire over the strength of a current in this new development of that most mysterious of all agents, electricity. It will not cost more than half as much to install a telegraph system on my plan as it would on the old system. The instruments are slightly more expensive, but I imagine a decrease in cost would be brought about by the absence of miles of wire and poles."

EXPERIMENTS WITH THE MARCONI TELEGRAPH—THE RECEIVING APPARATUS IN A BOAT AT SPEZIA.

W. H. Preece, electrician to the British post office, made the following report of the experiments in England last year by Marconi:

Mr. Marconi utilizes electric or Hertzian waves of very high frequency, and they depend upon the rise and fall of electric force in a sphere or spheres. He has invented a new relay which for sensitiveness and delicacy exceeds all known electrical apparatus. The peculiarity of Mr. Marconi's system is that, apart from the ordinary connecting wires of the apparatus, conductors of very moderate length only are needed, and even these can be dispensed with if reflectors are used. His transmitter is Professor Righi's form

of Hertz's radiator. Two spheres of solid brass four inches diameter are fixed in an oiltight case of insulating material, so that a hemisphere of each is exposed, the other hemisphere being immersed in a bath of vaseline oil. Two small spheres are fixed close to the large spheres and connected each to one end of the secondary circuit of the induction coil, the primary circuit of which is excited by a battery, thrown in and out of circuit by the Morse key. Now, whenever the key is depressed sparks pass, and since the system contains capacity and electric inertia, oscillations are set up in it of extreme rapidity. The line of frequency of oscillation is probably about 250,000,000 per second. The distance at which effects are produced with such rapid oscillations depends chiefly on the energy in the discharge that passes. A six inch spark coil has sufficed up to four miles, but for greater distances we have used a more powerful coil—one emitting sparks twenty inches long. It may also be pointed out that this distance increases with the diameter of the spheres, and it is nearly doubled by making the sphere solid instead of hollow.

"Marconi's relay consists of a small glass tube four centimeters long, into which two silver pole pieces are tightly fitted, separated from each other by about half a millimeter—a thin space which is filled up by a mixture of fine nickel and silver filings, mixed with a trace of mercury. The tube is exhausted to a vacuum of four millimeters and sealed. It forms part of a circuit containing a local cell and a sensitive telegraph relay. In its normal condition the metallic powder is virtually an insulator. The particles lie in disorder. They lightly touch each other in an irregular method, but when electric waves fall upon them they are polarized, and order is installed. They are marshaled in serried ranks, they are subject to pressure—in fact, they "cohere"—electrical contact ensues and a current passes. The electrical resistance of Marconi's relay—that is, the resistance of the thin disk of loose powder—is practically infinite when it is in its normal or disordered condition. It is then, in fact, an insulator. This resistance drops sometimes to five ohms, when the absorption of the electric waves by it is intense. It, therefore, becomes a conductor. Marconi "decoheres" by making the local current very rapidly vibrate a small hammer head against the glass tube, which it does effectually, and in doing so makes such a sound that reading Morse characters is easy. The same current that decoheres can also record Morse signals on paper by ink. The exhausted tube has two wings, which, by their size, tune the receiver to the transmitter. Choking coils prevent the energy escaping. Oscillations set up in the transmitter fall upon the receiver tuned in sympathy with it, coherence follows, currents are excited, and signals made.

"In open, clear spaces within sight of each other nothing more is wanted, but when obstacles intervene and great distances are in question height is needed, and tall masts, kites and balloons have been used. Excellent signals have been transmitted between Penarth and Brean Down, near Weston-super-Mare, across the Bristol Channel, a distance of nearly nine miles. Mirrors also assist and intensify the effects. They were used in the earlier experiments, but they have been laid aside for the present, for they are not only expensive to make, but they occupy much time in manufacture. It is curious that hills and apparent obstructions fail to obstruct. The reason is probably the fact that the lines of force escape these hills. Weather seems to have no influence; rain, fogs, snow, and wind avail nothing." For our engraving we are indebted to L'Illustrazione Italiana, and for our portrait to the Illustrirte Zeitung.

SECTORLESS WIMSHURST MACHINES.*

By S. M. KEENAN.

THERE exists a prevailing idea that sectors are absolutely necessary on a Wimshurst influence machine, while in point of fact they are somewhat of a detriment when a large output and long sparks are required. The only objection to sectorless machines is their inability to self excite. This is a minor consideration in a large machine, as a charge is readily imparted and can be retained, often for hours, while the machine is idle. A rod of vulcanite, gutta percha, glass, wax, etc., excited by any of the well known methods, and held opposite the neutralizer, easily imparts a charge. Any particular sign can be given to either side. If the machine be incased and it is not desirable to open the case, a small self-exciting machine may be placed in the case or under it and proper connections made with the prime conductors. These connections, likewise the attachments for imparting motion to the exciter, may be controlled from the outside. Similar arrangements are made use of by Waite & Bartlett, by Van Houten and by Ten Broeck to excite their large Holtz machines.

The only requirements necessary to change a sectored to a sectorless machine is to attach several brushes or points to each section of the neutralizer and discard the sectors. It makes little difference whether brushes or points are used, the results are about the same. When brushes are used they gradually wear off and require renewing, whereas points are free from this objection, as they do not touch the glass. Points, however, require very careful adjustment, particularly in large machines with multiple plates, as they are liable to scratch the shellac off the plates or perhaps fracture them. The more of the radial surface brushed or that passes in front of the points, the greater the output. There is, however, a limit, as a spark is liable to jump from one collector to the other by way of the neutralizer if the end of the latter is very near the center. A little experimenting will soon give the proper positions. To adapt the machine for the production of long, thin sparks, or short, thick ones, it is well to provide adjustable neutralizers and collectors.

The first published notice of a sectorless Wimshurst appeared in La Nature April 14, 1894. The machine therein described is the embodiment of an idea suggested by M. Pellissier in 1891 in the Journal de Physique. This machine, constructed by Mr. Bonetti, appears to have been preceded by one made by A. J. Picolet. The essential features of both are the same, the only difference is that Mr. Bonetti used several brushes on the neutralizer, while Mr. Picolet employed points. Mr. Bonetti's machine measured by a Lane electrometer, according to the authoritative statement of Mr. D'Arsonval, who carefully tested it, "gives a discharge three times greater than a machine of similar dimensions provided with sectors." Illustrations and full descriptions of Picolet's and Bonetti's machines may be found in the SCIENTIFIC AMERICAN, May 26, 1894.

The writer was constructing a two-plate, 18 in. machine, when the description of Bonetti's machine appeared, and decided to try it before the sectors were placed on the disks. A rubber comb passed through the hair once or twice excited the machine, but the discharge was insignificant, due to the small surface brushed, there being employed but the four brushes as used on the sectored machine. When the room was darkened the glow appeared only in the region of these brushes. A wire was then passed diametrically across the plates on each side and fastened to the ends of the neutralizing rods. Tinsel brushes were attached 1 in. apart on

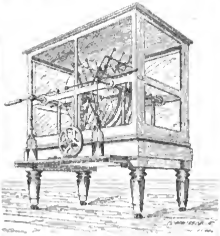


FIG. 1.—SECTORLESS WIMSHURST MACHINE.

the wires and pressed gently against the glass. By this arrangement almost the entire surface of the disks was brushed. Upon exciting the machine the effect was magnificent. Powerful sparks 8 in. long passed between the knobs.

An adjustable neutralizer has been substituted for the temporary wires. This machine never fails to work when a Voss or regular Wimshurst will excite. Some days during the summer when the atmosphere is very humid it will not work, nor will any other, unless it be incased and drying material placed in the case. Under similar conditions, with an exciter in the case, a sectorless machine will work during any weather. There are two sets of plates for this machine, one with and one without sectors. But a few moments are required to change it from one to the other. Careful comparisons have been frequently made, with the result always greatly in favor of the latter.

A 40 in., two disk, sectorless machine was constructed last year for Roentgen ray work, but it is not suitable for exciting Crookes tubes, owing to the small output in current. Two things are essential for exciting Crookes tubes with a static machine—multiple plates or very high rotary speed. As 40 in. glass disks cannot be thus rotated, it can easily be seen why this machine is unsuitable for Roentgen experiments.

The writer has lately constructed a twelve-plate, 32 in. diameter, sectorless machine, which answers so perfectly every purpose of experiment and electro-therapeutics that a brief description may prove of some interest. Fig. 1 gives a general idea of the machine, with the exception of the exciter, which is not shown in the sketch. The driving pulleys and bosses are the same as on an ordinary machine, with the exception that the steel shaft for the pulleys turns in roller bearings. The rest of the machine is entirely different from Wimshurst's. The base frame is made of $3\frac{1}{2} \times 3\frac{1}{2}$ in., kiln-dried yellow pine, and mounted on suitably turned legs. This base gives a very firm foundation to the machine and prevents the glass case from shaking

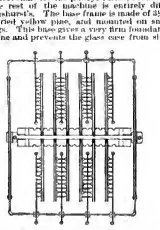


FIG. 2.—SECTION OF NEUTRALIZER.

when the machine is working. Two uprights are bolted to the inside of the side pieces and are slotted at the top to receive the steel shaft carrying the plates.

Fig. 2 shows a section of the adjustable neutralizer. This consists of a rectangular frame that passes entirely around the plates and is mounted on the disk shaft by double knobs. These knobs are tapped for a piece of tubing the same size as the bushing of the bosses and serve as bearings for the shaft. Taper-bored ball nuts are fitted on each end of the cross arms and hold the transverse rods near or remote from the edges of the plates. The radial rods that carry the brushes are mounted on the transverse rods by cross-bored knobs that slide on the transverse rods. By means of set screws these knobs may be set in any position; likewise the radial rods. By this combination, which was made purposely for wide adjustments in experimenting, the neutralizers may be placed at any angle, the radial rods may be all raised or lowered together or separately, and, in fact, any adjustment desired may be made in a moment. This rather complex neutralizer adds considerably to the expense of the machine, but is very desirable when careful investigations are required. The radial rods carry alternate brushes and points set $1\frac{1}{2}$ in. apart, and brush any portion or all of the plate as desired. The brushes and points are interchangeable, and hence brushes alone or points alone may be used.

The prime conductors (see sections, Figs. 3 and 4) are supported on vulcanite posts and the discharge rods fitted into either ends of these conductors, affording the use of the dischargers from either side of the ma-

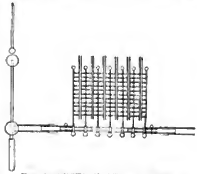


FIG. 3.—SECTION OF COLLECTOR.

chine. The collecting combs are adjustable up, down and sideways on the prime conductors. As window glass plates of large size are more or less "dished," this arrangement of the collecting combs is desirable owing to the fine adjustment it affords.

The Leyden jars may be placed inside the case or outside on a movable shelf. The external coatings of the jars are connected underneath the shelf by a sliding switch that protrudes therefrom close to the hand of the operator, enabling him to produce the spark or brush at pleasure. Two binding posts are connected to either portion of the switch for administering an induced current or for attachment to the primary of a D'Arsonval or similar high frequency transformer. These binding posts carry sliding dischargers for the regulation of the induced spark. By these the induced current may be made to assume a continuous or an interrupted oscillation. By them the volume of the direct discharge may likewise be controlled to a nicety. This has been found very serviceable in Roentgen ray experiments in conjunction with a regulated spark gap in the main circuit. When a Crookes tube is placed in the direct circuit—the best method by far—and the induced circuit closed, fitful sparks generally pass across the gap, rendering the illumination of the tube very bright but inconstant. If the induced circuit be opened beyond sparking distance, the discharge at the gap will be constant, but often too weak for powerful excitation of a tube of high vacuum. But, if the induced dischargers be separated gradually, a point will soon be found at which the tube becomes brightly fluorescent and very constant, giving rise to abundance of Roentgen rays which render quite distinct in the fluoroscope the shadows of the deeply seated bones.

The case is made in two sections and may be removed at pleasure, as the operating parts of the machine are constructed independent of the case. To remove the case, the key bolts for holding the dischargers to the prime conductors are removed and the dischargers taken off, the hooks at the top of the case opened and each half section lifted off the base separately. This is particularly advantageous for the purpose of replacing broken disks.

This machine has been in operation for three months in the Wayne County (Mich.) hospital, and has given the very best of satisfaction to the physicians in charge. It embodies all the latest features for electro-therapeutic treatment and has proved a valuable remedial agent in many diseases. With suitable Leyden jars it produces powerful sparks 15 in. long and abso-

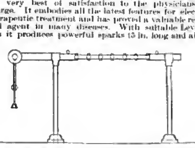


FIG. 4.—SECTION OF PRIME CONDUCTOR.

lutely deafening. When a patient is placed on the insulated stool, connected with one of the dischargers, and the outside coating of the jars disconnected, powerful brush discharges several inches long and entirely painless may be drawn from any part of his body. For Roentgen ray work it is excellent. Its enormous output, suitably regulated, renders the largest tubes intensely active with perfect ease. Nor does it dangerously heat up a tube—the great fault of induction coils; after using it constantly for two hours or more the tube remains comparatively cool.

There are, no doubt, about this machine many features that may be greatly improved, rendering it thereby much more efficient, for it is exceedingly difficult to construct anything along lines of a radical departure and avoid errors.

* From the American Electrician.

DESCRIPTION OF A CLOSING TOW NET, FOR SUBMARINE USE AT ALL DEPTHS.*

By C. H. TOWNSEND, Assistant, U. S. Fish Commission.

RECENT experiments with closing tow nets in submarine explorations have yielded so much accurate information concerning the vertical range of pelagic life, that the construction of the Tanner intermediate tow net in 1891† may be said to have inaugurated a new era in the study of the pelagic fauna, characterized by exact knowledge of the depth of the forms collected.

The vertical distribution of the pelagic life gathered with the open tow nets of the Challenger expedition has necessarily been conjectural, the nets employed having been dragged open at all depths. Since then European investigators have employed several devices for closing submarine tow nets, but direct evidence as to their reliability, so far as the writer is aware, seems to be lacking.

Open tow nets of different forms have long been employed by the United States Fish Commission, while a closing collector, although of very limited capacity (the Sigsbee gravitating trap), has done service on the Coast Survey steamer Blake; but it was not until 1891 that a closing tow net of large size was brought into use. The Tanner tow net, closing tightly at any depth desired, has proved its efficiency during recent explorations conducted by the Fish Commission and by Mr. Alexander Agassiz, but its large size and somewhat complicated construction have prevented its use except by steam power from large vessels.

While towing a light surface net behind one of the small boats of the Albatross in an Alaskan harbor in the summer of 1894, the idea of a very simple closing net presented itself, which was at once experimented upon and gave satisfactory results. I at first used it in moderate depths only, but subsequently, having made one of heavier form than at first employed, the principle was found applicable to deep sea work as well as near the surface.

This form of towing net is, on account of its lightness and simplicity, convenient for use by hand from all kinds of small sailing craft and open boats. It can be rolled into a small package with all its attachments and carried readily in one hand. With a light tow line passed through a pulley slung from one of the boat davits of the Fish Commission steamer Albatross, it has been hauled in from depths of 20 and 30 fathoms by one man with very little exertion, and has not failed to work in a single instance.

In the summer of 1895 this net, constructed in larger and heavier form, with a net ring 3 feet in diameter, was used successfully on board the Albatross during fishery investigations in Bering Sea, at depths varying from 20 to 200 fathoms.

Following is a description of a closing net of medium size constructed for use on the Fish Commission schooner Grampus (Pl. 1, Figs. 1 and 2). It consists of a tow net with a folding ring suspended by rope slings from a tripping arm attached to the tow line, and is operated at will by a messenger. The ring to which the net is attached is hinged to fold, for the purpose of closing the net, and is supported by two sets of slings of nearly equal length, one set attached near the hinges, supporting the net in an open position, the other attached at right angles to the hinges, supporting it in a closed position.

Closing is effected by means of a tripping arm, from which the slings are suspended, and which, being tripped by a messenger, shifts the weight from the opening to the closing slings, with the result of closing the net. The tow line is attached to the lower end of the tripping arm, the upper end of which is hooked to a ring on the tow line. The opening slings are secured near the upper end of the arm, the closing slings to the lower end. A light messenger (Pl. 1, Fig. 3) sliding down the tow line detaches the messenger ring from the upper hook of the tripping arm, shifting the weight from the opening to the closing slings. A spring catch in the upper hook of the tripping arm keeps the messenger ring from slipping out of place until struck by the messenger, while a heavy ring-shaped weight, released by the tripping of the arm, slips from the lower hook of the arm down the closing slings and keeps the jaws from opening after they have been closed by the messenger. The accompanying figures, showing the net in both open and closed positions, illustrate its workings clearly.

The tripping arm is merely a piece of half-inch brass, ordinarily about 2 feet in length and of the shape shown in the cut. The ring is 2 feet in diameter, made of ⅜ by ¼ inch brass, and is essentially the same as that employed by Agassiz for use with his modified Chun-Petersen machine.* The messenger is a 2 pound bronze casting, in two parts, to lash around the tow line. A small lead sinker is lashed to the bottom of the net, of sufficient weight to carry it down clear of the ring, as it is, of course, lowered vertically and the vessel from which it is operated brought to a full stop. The net is light and of small mesh, preferably half inch. It is lined with bobbinet or mosquito netting, with a delicate inner lining of silk bolting cloth, the last being the real collector, to which the outer nets act as supports.

In this combination of three nets all are of full width to the bottom, where they are closed by a lashing, the inner nets being secured rather slack, in order to avoid strain upon them in towing. As used on board the Albatross, by steam power at all depths, the net and its appliances have been constructed somewhat heavier and stronger. Additional weight is secured by passing the tripping arm through a 60 pound shot, of the ordinary pattern used for sounding, the shot being secured by a bolt to prevent its slipping when the arm is capsized. (See Pl. 1, Fig. 4.)

A deep sea tow net, closed, with the folded jaws protecting its mouth, offers little resistance to the water, and can be heaved in rapidly without the danger of being torn away from an open and widespread net ring, while the friction upon the contained organisms is reduced to the minimum.

The time gained in deep sea work, with a folding ring net which will permit of the steam winch reeling in at full speed, and the small stowage space required on shipboard for a net of this pattern, are matters of considerable importance. The readiness with which this net can be carried on deck by one man and attached to the wire dredge rope without complicated adjusting is perhaps the most important point of all in its favor, while its cost is less than that of any intermediate net hitherto employed.

This device has also been constructed in very light form, with a net ring 18 inches in diameter, for use in lakes or at very moderate depths, the heavier outside net being done away with, leaving merely the mosquito netting with its lining of silk bolting cloth.

In this form it will be useful in gathering the minute life, crustacea, etc., of the Great Lakes, a knowledge of which is essential in its bearing upon the food of young whitefish and other important fishes now being propagated artificially.

The folding ring tow net is also available for use as an ordinary surface tow net, without the employment of the messenger and the lead sinker.

The collections made by the Albatross during the past summer with the intermediate net were from depths of 20 to 200 fathoms, the net being lowered in one instance to 575 fathoms, when it accidentally touched bottom. The forms obtained consisted principally of minute crustacea, medusæ, annelids, and fishes, which have not yet been studied; but the ordinary surface tow net having been used at the same stations as the intermediate net, the contents of the two nets were usually found to differ somewhat in character and quantity. As a rule, the surface net contained a slightly greater quantity of material than the intermediate net, but at some stations the reverse was the case, while the intermediate net sometimes brought up forms not taken at all in the surface net. The towings, 18 in all, were made along the border of the submarine bank

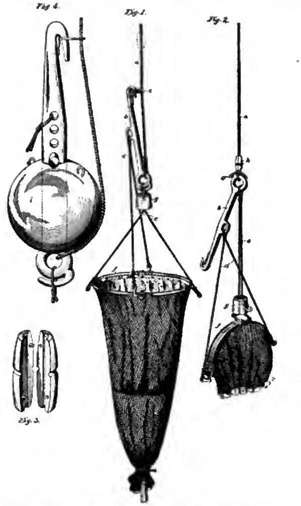


FIG. 1.—Showing net in position for lowering and towing; a, tow line; b, tripping arm; c, tripping ring; d, opening slings; e, closing slings; f, folding net ring; g, closing weight; h, closing messenger (see also Fig. 3). FIG. 2.—Showing net closed for heaving in. FIG. 3.—Closing messenger. FIG. 4.—Showing heavy tripping arm used on steamer Albatross, with 60 pound sounding shot attached as sinker for proper strain on wire tow line in deep sea work; i, common sounding shot—60 pounds.

PLATE 1.—CLOSING TOW NET.

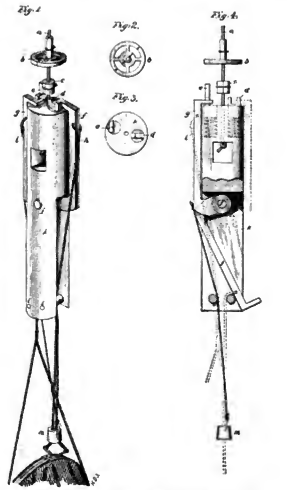


FIG. 1.—Showing net in position for lowering: a, wire tow line; b, second messenger—to close; c, first messenger—to open; d, plunger securing right arm; e, plunger securing left arm; f, right arm; g, left arm; h, closing slings; i, opening slings; j, bolt securing tripping arms; k, body of machine (1 ft. 3 in. long); l, bolts holding net lines on center of gravity; m, closing weight. FIG. 2.—End view of second messenger. FIG. 3.—End of machine, showing position of plungers. FIG. 4.—Showing right arm tripped, springs to plungers, and knot securing tow line.

PLATE 2.—CLOSING TOW NET.

* From a pamphlet issued by the U. S. Fish Commission.

† Tanner, Rept. U. S. Fish Com. 1889-91, pp. 250-260. Ball. U. S. Fish Com., 1894, pp. 143-151.

* Agassiz, Bull. Mus. Comp. Zool., 1892-93, vol. xxiii, p. 45, etc.

south of the Pribilof Islands during the month of August, from lat. 54° to 56° N. and long. 167° to 172° W. Soundings were from 75 fathoms, on the bank, to 1,901 fathoms beyond it. There can be no doubt that there is an abundance of pelagic life at 200 fathoms in this part of Bering Sea.

After some experience with the single tripping arm described, I designed a machine for opening as well as closing the jaws of the tow net, which worked satisfactorily (Pl. 3). It is a combination of two tripping arms, for operating which two messengers are employed on the same tow line, the second striking a separate detacher from the first. A rough experimental machine, constructed on board the Albatross, was used successfully in port, but did not have strength to withstand the strain of towing at sea. Experiments indicate, however, that a properly constructed machine of the same pattern would accomplish the desired result. Its use in place of the single tripping arm permits of the folding ring tow net being lowered in a closed position, the closing slings being attached to the right arm, the opening slings to the left. The arms are bolted to a bar of brass about 2 feet long, suspended from the tow line, and in position for use are hooked upright to detachers released by messengers. The first messenger tripping the right arm, the jaws of the net fall apart for towing. The second messenger, in turn, tripping the left arm, the weight is thrown back on the slings of the right arm, closing the jaws. A ring-shaped weight around the right slings, and suspended from a hook on the left arm, holds the jaws together for lowering. It is released upon the tripping of the left arm, and slips again to its position upon the right slings, holding the jaws together for heaving in.

The net being closed tightly in going down, it is not necessary to stop the vessel and lower it vertically.

UNDERGROUND PHOTOGRAPHY.*

THE value of photographs in a mining report is evident to everyone, and there are few engineers who have not wished at various times that they could illustrate their papers by means of the camera. I will endeavor to show how, with the simple appliances that can easily be carried into a rough country, photographs can be secured which will much more than repay the slight cost and trouble in taking.

The camera is the most important part of the outfit, and this should be the best obtainable, and in most cases where portability is an object, carrying not larger than a 5 × 7 in. plate. It should be folding, self-containing and, where necessary, focusing by a scale in front, without the aid of the ground glass. The camera should have double swing-backs and sliding front. The tripod, as in surveying, should be adjustable to different heights, and is much steadier by having its legs in only two sections. One should have two lenses, wide angle and rectilinear, for underground and surface work, and these should be able to cover a larger plate than the camera carries, so that the image is sharp when both sliding front and swing backs are used. The best lenses are none too good, as great rapidity is almost always an advantage. The most useful shutter is probably the automatic Bausch & Lomb, with iris diaphragm. I use a 4 × 5 in. folding Kodak, sliding front and double swing-back, Bausch & Lomb lens and shutter. The Poco, Premo, Wizard and some other cameras, when fitted with wide angle lenses, are admirably adapted for underground work, and are very portable.

The plates used should be the quickest possible to obtain. Seeds 27 and Carbutts, also the quick plates of some other makers, work nicely, but little or nothing can be done with a slow plate. Films rarely give complete satisfaction, but where great portability is required cut films seem to work fairly well. The lamp is very important. I have found the "Perfection" lamp (Fig. 2), while not perfection, perhaps the nearest to it of any lamp. The "Perfection" is a magazine lamp, and will serve for from 5 to 15 exposures without refilling. An admirable lamp is made by taking a clay pipe, wiring on to it a lamp wick. The magnesium powder is put in the bowl and the wick, previously soaked in alcohol, is lighted. The magnesium is blown up through the flame by means of a rubber tube or a bulb such as is used with the shutter of the camera. This outfit, costing about 1½ cents, will make as good a picture as the best lamp in the market, but has to be filled each time it is used. This, however, is perhaps an advantage, as it enables the photographer to control the intensity of his flash by the amount of magnesium used, which has to be guessed at with a magazine lamp. Fig. 1 shows the contrivance ready for use.

Blitz-pulver may be used without a lamp, and simply ignited on a rock or shovel. It is easier to regulate the amount of light and much quicker, but it is harder to direct the light and makes more smoke. Magnesium powder with a lamp is, in my opinion, far nicer, less expensive, and in most cases better than blitz-pulver. A box to contain the instruments, plate holders, etc., together with a flask of alcohol for the lamp, is useful. At all events, they should be carried in such a way as to be easily found in obscure light.

In taking the picture it is not necessary to focus very carefully, as the wide angle lens is very nearly universal focus. The best way is to focus with the ground glass on some object about 20 feet away, make some kind of a mark and use this where the light is obscure underground. The camera must be leveled carefully, as the wide angle distorts somewhat, even under the best conditions. This operation is quickened by having a level or a pair of levels on the swing-back. If the swing-back is level, the picture will not be distorted, but the plates must be perpendicular, no matter where the lens is pointing. A ball and socket joint aids in leveling, but makes the camera less steady. By moving candles or lights in front of the camera one can tell exactly how much ground the lens covers and just what the photograph will include. There is rarely enough light to see the image distinctly on the ground glass. Everything being ready, the slide is withdrawn from the plate holder, the shutter opened, unless it was left open in the beginning. The lamp is set going from behind or to one side of the camera a few inches back of the lens. The flash must never get in front of the lens, though candles or lights may be left burning if they are not moved. The exposure lasts according to the size of the workings, and the length of the flash can only be learned by experience. Perhaps three thimblefuls of pure magnesium, or about twice the quantity of blitz-pulver, would light an ordinary sized drift or stope. If the photographer stands behind the camera and causes the lamp to move in an arc from one side over the top to the other, blowing slowly all the while, to throw the light in all directions, the best results can be obtained. A reflector is sometimes useful.

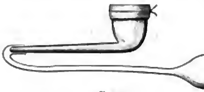


FIG. 1.

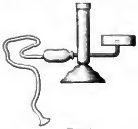


FIG. 2.

Care should be taken not to let the smoke get in front of the camera, as this fogs the picture. This is very difficult in taking low drifts and upraises. In such places it is usually necessary to use blitz-pulver where the plate is exposed and the flash finished before the smoke really gets started. In all cases it is well to study the direction of air currents, both while making the flash and also when a good exposure is desired. I have found it almost impossible to take a second good picture within a reasonable time, even in well ventilated mines. After flashes as well as after blasting, even when the smoke is gone, there seems to remain a practically invisible gas which throws the objects in the picture all on one plane and makes the photograph look like a bass-relief. In taking pictures of shaft houses and mills even in daylight it is often advisable to give one or more flashes to bring out more detail in obscure places. The contrasts otherwise are liable to be too great.

A few words should be added on the subject of developing and printing. Underground flashlights, having so little contrasts, need a good light in developing. They should be developed slowly, and will often be improved by intensifying later on. The author prefers negatives bordering on dense, and thinks that it is difficult if not impossible to over-develop a properly exposed or an under exposed plate. In the boxes with the plates will be found formulas from the makers for developer, intensifying and reducing solutions, and these are usually best suited to the particular brand of plates. Eastman's eikonogen powders and Dr. Anderson's eikonogen cartridges are very useful in traveling. They are cheap, take up little room and do very good work. In developing in tents and the like, starlight or indirect moonlight does little or no harm.

The engineer rarely does his own printing, but he will be rewarded as a rule when he does. Platinum paper gives the best results, as it tones down the sharpness of the ordinary flashlight negative. It is the easiest and quickest paper to handle, though somewhat more expensive than the gelatine papers. Bromide paper, except for very thin negatives, is not as good as platinum, as it is likely to intensify the faults of the negatives. It is admirable, however, for enlargements, and most negatives taken by flashlight can be enlarged with good results.

The accompanying illustrations are reproductions of underground photographs taken in mines in the vicinity of Clear Creek and Idaho Springs in Colorado. They show what can be done with the camera in a mine.

BEGINNING OF A STOPE.

JUNCTION OF TWO VEINS.

PHOTOGRAPHS TAKEN IN THE PRUSSIAN MINE, COLORADO.

*Written for the Engineering and Mining Journal by James Underhill.

MOISTURE IN COAL.

THE characteristics of different coals with reference to their ability to absorb moisture vary between wide limits. Anthracites are almost wanting in this property. The surfaces of the lumps of anthracite coal become wet when exposed to rain; but there is scarcely any penetration of the moisture into the structure. The semibituminous coals, of which the Cumberland and Pocahontas are examples, absorb some moisture because a considerable portion is usually in the condition of dust; but the part which consists mainly of lumps absorbs little more water into the body of the fuel than does anthracite coal. If a small pile of Cumberland coal which has been wet by the rain is left in the open air, the moisture will quickly and almost wholly disappear after one or two days' drying. The percentage of moisture which these coals contain when subjected to the ordinary exposure of transportation and storage in an unprotected pile seldom reaches as high a point as 5 per cent. The bituminous coals have different properties in this respect. Their power of absorbing moisture is much greater. Some of these coals, which have all the appearance of being practically dry, will, when tested for moisture, shrink 5 per cent. or more. The water enters the structure, and becomes in some degree hydroscopic. The surface indications fail to reveal it. These coals sometimes contain no less than 15 per cent. of moisture, and yet they appear no more moist on the surface than Cumberland coal, which holds but 3 per cent.

It is a matter of some concern how to treat the moisture in the case of wet coal used on an evaporation test. It is agreed that the basis of computation should be the weight of dry coal; but the point at issue is whether the boiler should be given credit for the evaporation of the moisture in the fuel. The subject does not have the importance with the higher grades of coal, because these seldom contain much moisture. As it happens, the coals which contain the large quantities are the ones which are often of the poorest class. With an evaporation, for example, of 5 to 1 and 15 per cent. moisture in the coal, the credit to which the boiler is entitled for evaporating this moisture is 3 per cent.; whereas, in the case of the high grade coals giving, perhaps, 10 to 1 evaporation, with 5 per cent. moisture, the percentage is only one-half of 1 per cent. It would appear, then, that the subject might in some instances be of great importance.

How this should be decided is a question depending upon the object in view. If the commercial value of the coal is the thing desired and the moisture is one of its usual characteristics, then no allowance of any kind should be made for it. The moist condition is the state in which it is purchased, and that is the condition on which the results should be based. If the efficiency of the boiler as a steam generator is desired irrespective of the coal used, it seems certain that the boiler should have the benefit of every advantage to be derived from the use of dry coal, and, under those circumstances, it should have the credit of evaporating the moisture

which the coal contains the same as though moisture was in the interior of the boiler. The boiler should in no respect be made to suffer because of the heat lost in this way.—Engineering Record, U. S. A.

ALUMINUM IN KNITTING MACHINERY.*

By GEORGE D. RICE.

FIVE years ago the price of aluminum was $3 per pound. Now it can be purchased for 50 cents per pound. With the reduction in price has come a gradual employment of the metal in all lines of machine work.

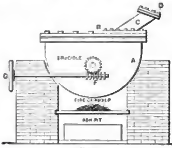


Fig. 1

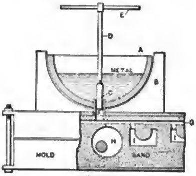


Fig. 2.

The writer has interviewed knitting machine builders who have experimented with aluminum and aluminum bronze castings in parts of knitting machinery that require great strength, and other builders who are contemplating work on this line.

As the processes of treating and casting aluminum for knitting machinery parts are quite new, the accompanying illustrated description may be useful to those knitting machine builders who wish to try the new metal. Aluminum castings can be bought at the foundries from 45 cents per pound and upward. The price for aluminum hardened with other alloying metals is a few cents higher per pound. The tensile strength of the hardened metal averages 21,000 pounds per square inch, thus making it well adapted to many small parts of the knitting machine. Tests have demonstrated that the shrinkage of aluminum is about one-quarter of an inch in a twelve-inch sample.

* From Machinery.

Although advisable to buy the aluminum crude castings already hardened, the purchaser may increase the hardness by adding zinc, manganese, tin, brass, nickel or other like metals. Aluminized zinc brass makes a most durable metal for knitting machine needle cams.

PROCESS OF MAKING ALUMINUM CASTINGS FOR KNITTING MACHINERY.

Electrical machinery builders are now using this metal in places where strength is needed. For general purposes, however, a good alloy from which to make cams, bearing sleeves, small castings and the like for knitting machinery may be made as follows:

Aluminum	95·00
Antimony	3·04
Tin	0·96
Copper	0·94
Tungsten	0·06
Total	100·00

The tensile strength of parts made from this alloy is 25,000 lb. It can be cast in sand moulds. The melting and casting of aluminum alloys into knitting machinery parts requires an equipment something like that shown in the diagrams, the first of which is a sectional view of the melting pot or crucible, A, which is set up in a brick affair over a coke fire. Coke must be used, and

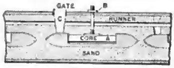


Fig. 3

Fig. 4

Fig. 5

Fig. 6

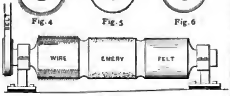


Fig. 7

not coal, as the gases from the latter are liable to impregnate the metal. The crucible can be balanced on a shaft, on which shaft should be keyed a gear. A worm shaft can be arranged to engage with the cogs as shown at F, and by turning this shaft with a handle at G, the crucible can be poured. The lid, B, is provided with a spout, C, the end of which can be closed with the cap, D. The latter is, of course, removed when the metal is poured. Next the ladle should be erected, as shown in section in Fig. 2, in which the ladle itself is marked A, and the pouring gate channel, F. This gate is stopped with the plug, C, and the latter raised and depressed by means of the shaft, D, and handle bar, E. By this arrangement the metal is poured from the bottom and scum is avoided. The arrangement of the mould does not differ enough from ordinary descriptions to call for detailed account.

The gate channel leads into the runner, G, and the metal flows through to the moulds, H and I. Perhaps in this connection it may be well to refer to the method of casting aluminum shuttles. The mould box is shown in sectional view in Fig. 3, and the gate for pouring is at C, where it branches off into the runner, and several shuttle moulds are connected with it. The core of the hollow of the shuttle is indicated at A, consisting of a correctly shaped metallic piece, wound with hemp and swept with loam. It is held in place by the stem, B. After the castings are taken from the moulds, the finishing processes call for the usual chipping, cleaning and smoothing. Some special wheels are used in the work, and these are shown in the next sketches, that in Fig. 4 being a side view of a "scratch" wheel made by covering a wood cylinder with medium sized fancy clothing wire. The use of this wheel is to remove fins, etc., from the castings. The next wheel (5) is covered with fine emery, for evening off the surfaces, and the last wheel (Fig. 6) is for buffing purposes, being covered with felt or pile fabric.

These wheels may be set up separately in stands of wood and revolved by belts, or all may be arranged on one cylinder with a division between each, as shown in Fig. 7.

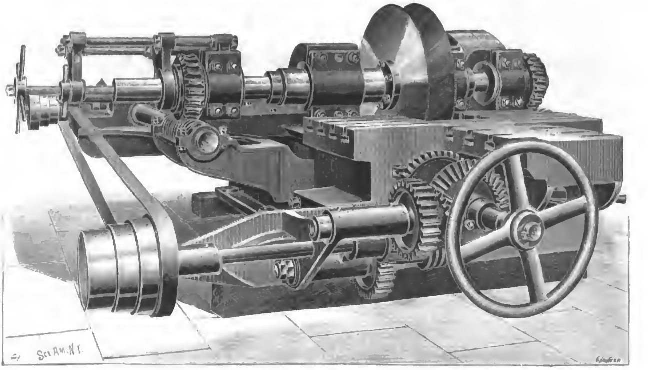
If the castings should prove too brittle, anneal them by heating to cherry red and dipping in cold water. Three points are claimed for the aluminum hollow castings. They are lighter, tougher and look better than iron or steel castings. On the other hand, they cost more, but not much more than iron or steel parts. Concerning looks, this is quite an item in these days, and if the aluminum alloy castings are given the so-called nickel polish, a very attractive machine is made. This nickel polish is easily and cheaply applied, consisting in buffing the surfaces of the castings or other aluminum parts, and putting on nickel rouge or crocus composition. The buffing is done in this case with soft muslin or loose cotton wheels. A shiny nickel-like polish results and sets off the knitting machine to advantage.

A RAPID METHOD FOR THE DETERMINATION OF SILICON IN SILICO-SPIEGEL AND FERRO-SILICON.

C. B. MURRAY and G. P. Maury, in the Journal of the American Chemical Society, 1897, 19, 138, 139, describe the following method: 0·5 gr. of the sample is placed in a porcelain or platinum dish; 30 c. c. of water, 10 c. c. of hydrochloric acid (sp. gr. 1·20), and 12 c. c. of sulphuric acid (one part of sulphuric acid [1·84 sp. gr.] to three parts of water) are poured on it, and the contents of the dish heated until copious fumes of sulphuric acid are given off. When cool, 10 c. c. of hydrochloric acid are added, and the whole is heated to soften the sulphate of iron; finally it is treated with 75 c. c. of water, and raised to boiling. The heating is discontinued, and note taken as to whether there is any effervescence when boiling ceases. Should this occur, the liquid must be evaporated until copious fumes of sulphuric acid are again given off, and then it is treated in the manner above described. The solution is filtered, washed with hydrochloric acid and hot water, ignited in a platinum crucible, and weighed. A few drops of sulphuric acid and enough hydrofluoric acid are added to dissolve the silica. The liquid is then evaporated to dryness, heated to decompose the sulphates, cooled and weighed. The difference in the two weights represents silica. The whole operation can be accomplished in thirty minutes.

COLD SAW FOR CRANK WEBS.

THE accompanying engraving illustrates a heavy cold saw just constructed for a Midland firm by Messrs. Hill & Sons, St. George's Works, Derby. It is specially intended for sawing out crank webs. Each saw is fitted with the makers' patent flush sides. One is stationary, the other is movable to suit the traverse of the telescopic saw spindle. The engraving is self-explanatory.—The Engineer.



SAW FOR CRANK WEBS.

[Continued from Supplement, No. 1130, page 18059.]

PERPETUAL MOTION.—II.*

The two self-movers, which it has been claimed were really such, were the inventions of the Marquis of Worcester, author of the "Century of Inventions," and Jean Ernest Elie Bessler Orffyré, or Orphyreus, who is usually named Orffyreus in English and German works. The latter was born in 1680 near Zittau, in the department of Alsace, France, and early studied theology and medicine, but his erratic genius was only to be satisfied by engaging himself in the pursuit of a variety of the mechanical arts and painting. He asserts that it was during his search for whatever might prove curious and valuable that he discovered perpetual motion, and between the years 1712 and 1719 made two machines on his system; one he desired to exhibit publicly, but broke it up rather than submit to the payment of the license or tax required by the government of Cassel; the other he destroyed after its having been unfavorably reported on by M. 'S Gravesande. He published in German and Latin a book or pamphlet entitled "Le Mouvement Perpétuel Triomphant," quarto, dated Cassel, 1719. Other accounts differ respecting the breaking of the second machine, and, on insufficient authority, Mr. Partington styles him a "German mechanic." Dr. William Kenrick, among his miscellaneous works, wrote "An Account of the Automaton or Perpetual Motion of Orffyreus, with additional remarks," in editions dated 1770 and 1771. Orffyreus died in November, 1745.

The following is a description of the Marquis of Worcester's wheel, described in the 56th article of the "Century of Inventions" as "An Advantageous Change of Centers."

"To provide and make that all ye weights of ye descending syde of a wheele shal be perpetually further from ye center, then those of ye mounting syde, and yett equal in number and heft of ye one syde as ye other. A most incredible thing if not seene, butt tryed before ye late King of happy and glorious memorye in ye Tower by my directions, two Extraordinary Embassadors accompanying his Matie and ye D. of Richmond, D. Hamilton, and most part of ye Court attending him. The wheele was 14 foote over, and 40 weights of 50 pd apiece; S Wm. Belford, then Lieut of ye Tower, and yet living can justify it with severall others; they all saw that noe sooner these great weights passed ye Diameter Line of ye vpper syde but they hung a foote further from ye center, nor no sooner passed the Diameter line of the lower syde, butt they hung a foote nearer; bee pleased to judge ye consequence."

Of the inventions of these two men Dircks says:

"The only appeal that can be made in apology for the pursuit of perpetual motion is derivable from the results represented to have been obtained by the Marquis of Worcester in one instance and by Orffyreus in another. All the circumstances relating to their singular inventions excite our curiosity, raise our skepticism and induce us to pause in our decision. Let us first consider the inventors personally; and, secondly, their inventions and the circumstances attending their exhibition. The two men were of very different character and position in life. The first noble by birth, of ancient lineage, loyal to the extent of sacrificing his property in support of the cause of Charles I, and evidencing by his prayers his truly religious sentiments. About or before 1648 (as the King died 1649), he exhibited his wheel or perpetual motion in the Tower before his Majesty, two extraordinary ambassadors, the Duke of Richmond, Duke Hamilton, most part of the Court and Sir William Belford, Lord Lieutenant of the Tower. We have to consider the upright character of the Marquis, his having invented the steam engine, his worthiness in all respects and the circumstances here detailed, and then ask ourselves: Little as science favors any belief in such an invention, can we see any reasonable grounds for error in this great experiment, or believe that a person so distinguished and so much to be admired in all other respects could thus boldly and recklessly deceive himself, his noble company and the public, taking ten years or upward to elaborate and record a gross falsehood? It seems incredible, and true respect for the marquis' memory will go far to maintain doubts respecting the infallibility of all mathematical demonstrations adverse to the possibility of a self-motive power. Secondly:

"Orffyreus was of humble origin, had versatile talents, and fickle, discontented, unsettled, irregular, and eccentric. He was ambitious, boasting and the very man to raise up enemies. Between 1712 and 1718 he made and destroyed in succession four wheels or machines. He had learned the art of clock making and several mechanical arts, and is supposed to have constructed or put these wheels together himself. He had a princely patron who wished to obtain practical results from the invention for manufacturing and other operations. A misunderstanding ensues; and from that time to his death, in 1745—at least twenty-eight years—the subject lies dormant and the invention dies with him. This last fact, coupled with the wheel having raised so great a weight as 70 pounds, makes a doubtful case still more doubtful; and particularly when, about the same time, Geiser imposed on the German public with a mere piece of clockwork as a true perpetual motion.

"The Marquis of Worcester's wheel was 14 feet in diameter; it was rotated by the action of forty 50 pound weights—2,000 pounds—an enormous weight, requiring some very laborious operations of the carpenter to erect a sufficiently strong framework. Its completion must have taken some time and led to frequent visits from the noble inventor, as well as experiments to test its correct working before offering a practical demonstration before majesty.

"Orffyreus' fourth or last wheel, at Hesse Cassel, was 12 feet in diameter, 14 inches broad and made of light oak framing and covered with oil cloth. It would revolve either way, and this alone casts a shade of doubt on there being any deception in practice with it. But, strange to say, it had power enough to raise 70 pounds to a considerable height. Its operations were seen and attested by so many that these broad facts rest not alone on the inventor's authority. It was so ingeniously made that M. Gravesande wrote to Sir Isaac Newton on the subject; and his letter and mathematical reasonings in reference to the matter appear in his works, edited by Prof. Lalande, 1774."

* Reprinted from the Scientific American, 1870-71.

The following is the letter written by Prof. S. Gravesande to Sir Isaac Newton in regard to the wheel of Orffyreus:

Sir: Dr. Desaguliers has doubtless shown you the letter that Baron Fischer wrote to him some time ago about the wheel of Orffyreus, which the inventor affirms to be a perpetual motion. The landgrave, who is a lover of the sciences and fine arts, and neglects no opportunity to encourage the several discoveries and improvements that are presented him, was desirous of having this machine made known to the world for the sake of public utility. To this end he engaged me to examine it; wishing that, if it should be found to answer the pretensions of the inventor, it might be made known to persons of greater abilities, who might deduce from it those services which are naturally to be expected from so singular an invention. You will not be displeased, I presume, with a circumstantial account of this examination. I transmit you, therefore, a detail of the most particular circumstances observable on an exterior view of a machine, concerning which the sentiments of most people are greatly divided, while almost all the mathematicians are against it. The majority maintain the impossibility of a perpetual motion, and hence it is that so little attention hath been paid to Orffyreus and his invention.

Fig. 5.

For my part, however, though I confess my abilities inferior to those of many who have given their demonstrations of this impossibility, yet I will communicate to you the real sentiments with which I entered on the examination of this machine. It is now more than seven years since I conceived I discovered the paralogism of those demonstrations, in that, though true in themselves, they were not applicable to all possible machines, and have ever since remained perfectly persuaded it might be demonstrated that a perpetual motion involved no contradiction; it appearing to me that Leibnitz was wrong in laying down the impossibility of the perpetual motion as an axiom. Notwithstanding this persuasion, however, I was far from believing Orffyreus capable of making such a discovery, looking upon it as an invention not to be made (if ever) till after many other previous discoveries. But since I have examined the machine, it is impossible for me to express my surprise.

The inventor has a turn for mechanics, but is far from being a profound mathematician, and yet his machine hath something in it prodigiously astonishing, even though it should be an imposition. The following is a description of the external parts of the machine, the inside of which the inventor will not permit to be seen, lest any one should rob him of his secret. It is a hollow wheel or kind of drum about 14 inches thick and 12 feet diameter, being very light, as it consists of several cross pieces of wood framed together, the whole of which is covered over with canvas to prevent the inside from being seen. Through the center of this wheel or drum runs an axis of about six inches diameter, terminated at both ends by iron axes of about three quarters of an inch diameter upon which the machine turns. I have examined these axes, and am firmly persuaded that nothing from without the wheel in the least contributes to its motion. When I turned it but gently, it always stood still as soon as I took away my hand; but when I gave it any tolerable degree of velocity, I was always obliged to stop it again by force; for when I let it go, it acquired in two or three turns its greatest velocity, after which it revolved for twenty-five or twenty-six times a minute. This motion it preserved some time ago for two months in an apartment of the castle, the doors and windows of which were locked and sealed, so that there was no possibility of fraud. At the expiration of that term indeed his serene highness ordered the apartment to be opened and the machine to be stopped, lest, as it was only a model, the parts might suffer by so much agitation. The landgrave being himself present on my examination of this machine, I took the liberty to ask him, as he had seen the inside of it, whether, after being in motion for a certain time, no alteration was made in the component parts; or whether none of those parts might be suspected of concealing some fraud; on which his serene highness assured me to the contrary, and that the machine was very simple.

You see, sir, I have not had any absolute demonstration that the principle of motion, which is certainly within the wheel, is really a principle of perpetual motion; but at the same time it cannot be denied that I have received very good reasons to think so, which is a strong presumption in favor of the inventor. The landgrave hath made Orffyreus a very handsome present to be let into the secret of the machine, under an engagement, nevertheless, not to discover or to make any use of it before the inventor may procure a sufficient reward for making his discovery public.

I am very sensible, sir, that it is in England only the arts and sciences are so generally cultivated as to afford any prospect of the inventor's acquiring a reward adequate to this discovery. He requires nothing more than the assurance of having it paid him in case his machine is found to be really a perpetual motion; and as he desires nothing more than this assurance till the construction of the machine be displayed and fairly examined, it cannot be expected he should submit to such examination before such assurance be given him. Now, sir, as it would conduce to public utility, as well as to the advancement of science, to discover the reality or the fraud of this invention, I conceive the relation of the above circumstances could not fail of being acceptable.

Partington, in his "Manual of Natural Philosophy," endeavors to interpret the somewhat enigmatical specification of the Marquis of Worcester by the accompanying diagram, Fig. 5, which it is self-evident almost at a glance can have no movement except that derived from external forces.

Making a long jump from the remote to the near, we shall next present an illustration of a perpetual motion machine invented by Horace Wickham, Jr., of Chicago, Ill., and on which a patent was obtained July 20, 1870. Mr. Wickham will thank us for placing him in such honorable company as the Marquis of Worcester, and our readers will perhaps be glad to see the form and essence of a machine which Western journals have greatly lauded as most wonderfully ingenious, etc., though if they can see how it generates any motive power, their mental vision will be superior to ours.

A is the bed or table upon which the standards for supporting different parts of the machine are secured. B B are the standards for supporting rocking beam, C. This rocking beam is pivoted at the center to the standards by the ring, D, and set screws. These centers have points like lathe centers. The other parts of the machine consist of a governor, fly wheel, etc.

C is the rocking beam, constructed in two parts and secured together by the bands, E. The rocking beam consists of two tubes; the upper one is made straight and the lower one in the form of a W. These tubes are connected together at their ends in such a manner as to allow the ball used to pass from the lower tube to the upper one by means of hinged inclined runways, F, and valve, G, and from the upper one to the lower, inside of the band, E, by the opening therein. The inclined runway, C, is hinged at one end to the upper tube, F, at the bottom of its opening or exit, made of the band, E, while the other end rests on the valve, G.

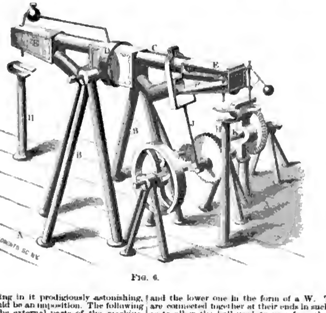


Fig. 6.

This valve has attached on its under side a pin which projects down through a hole in the band, E, a sufficient distance, so that, when the pin strikes the standard, H, secured to the bed or table, as the rocking beam oscillates it will raise the valve a short distance above the upper tube. The valve is made to incline toward the opening in the upper tube, so that the ball, when raised on the valve, will roll into the same, by means of the hinged inclined runway, F. I is a ball which runs in the upper and lower tubes; this ball is charged with a necessary amount of quicksilver, for giving more weight to the same, and also for giving a much quicker momentum to the ball. This

ball is to be used in the rocking beam for the purpose of unbalancing, and also to exert the pressure of its specific gravity on the same at whatever point or position it may be in, and in so doing it assists in oscillating it.

The pitman, J, connects the crank shaft with the oscillating beam. The rocking beam is provided, on the opposite end to which the pitman is attached, with a rod, on which is placed an adjustable weight, which is secured at any desired point by means of a set screw. This weight is for the purpose of counterbalancing the adjustable band provided with a rod to which the pitman is attached, and also the pitman. The governor is for the purpose of regulating the motion of the

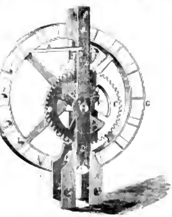


FIG. 7.

machine, and is operated through the medium of a gear wheel on the crank shaft, and other suitable gearing. The governor is constructed in the usual manner, excepting in using the cutoff valve, as in steam engines, which is dispensed with, and an automatic brake is used and operated by means of the rise and fall of the governor balls. The automatic brake consists of an elastic band, one end of which passes up through a hole in the guide rod projecting from the standard that supports the governor, and is connected to an arm projecting toward and partly around the upright shaft of the governor.

The tension of the band is regulated by nuts and screw-thread on the end of the band. The other end of the band passes under a wheel on the shaft, K, and is secured to a projecting arm on the standard that supports the governor. The crank shaft is counterbalanced.

I do not wish to confine myself to the precise construction of the rocking beam, as shown and described, as I intend using, in lieu thereof, wires, or rods, arranged in the form and shape of the rocking beam described, with mounted weights arranged to roll on them, which, in connection with the other parts of the machine, will accomplish the same result.

The lower tube can be made semicircular in form and shape instead of the form and shape of a W. Any number of rocking beams may be used, and more than one ball can be used in the rocking beam, by having inclined runways and valves on each end of said beam; the rocking beam so arranged that the balls drop from one tube to the other at the center of the beam, and rolling alternately from the center to the ends of the beam.

The rocking beam is oscillated by any power operating alternately on each end of the same, and which transmits motion to the other parts of the machine through the medium of the pitman and crank shaft, and for applying power to any other machine a pitman is secured on the opposite side of the rocking beam to which the pitman, J, is attached, or, instead thereof, pulleys, and endless belts on the shaft, K, or the crank shaft.

The spokes of the fly wheel are charged with quicksilver, for the purpose of giving weight to the same at any desired point, as it passes from the center to the circumfer[illegible] of the wheel.

It is claimed that this machine has run seven months without stopping, independent of any external force, which we do not believe, and we think our readers, after reading the above description of it, abstracted from the specification on file in the Patent Office, will concur with us in our belief.

In 1790, one Conradus Schwiers, a doctor of divinity, patented a "machine on a self-moving principle, or perpetual motion." Fig. 7 is a view of this machine, which, it will be at once seen, is an effort, since often repeated, to obtain a wheel so as to keep its center of gravity from ever falling directly under the axis while revolving. The following is the specification:

"Now know ye, that in obedience of the said letters patent, and the proviso therein contained, I, the said Conradus Schwiers, do hereby declare my said new invented self-moving principle, or perpetual motion, is made and performed in manner following, that is to say:

"Two stiles or uprights marked in the plan hereunto annexed, A, A, etc., and fastened together by the screws, 1, 2, 3, and to the base, between which stiles or uprights run the wheel, C, and the pinion, D, and the two double pinions, D, D, etc., over which double pinions run a double chain, etc., to which chain are fixed the buckets, F, F, etc. The chain is made with joints on each side and bars running across, equal in number to the cogs of the wheel, C. Upon the same axle with the wheel, C, on the farther side of the inner stile, A, runs the wheel, G, whose diameter is full double that of the wheel, C; and the pivot of the wheel, G, runs in the buck, H, as the other pivot of the same axle runs in the front stile, A. The wheel, G, is divided near the periphery into receptacles in number equal to the buckets on the chain, which receptacles are supplied with metal balls, I, I, etc., from the buckets, F, F, etc., by means of the gutter, K, which balls by their weight forcing round the wheel, G, and thereby lifting up the buckets, F, F, etc., on one side as they go down on the other side, discharge themselves again at the bucket, L, where they are taken up by the buckets, F, F, etc., and discharged again at the gutter, K, and are so repeated in a constant succession as often as any receptacle is vacant in the wheel, G, at the gutter, K, for their reception, and by that means the perpetual revolution is obtained, the upper ball being at the same time discharged from one bucket when the lower ball is taken up by another." A very common principle has been worked out to uniform failure in various ways, from the earliest to the latest times. It is shown in the accompanying diagram, Fig. 8, which represents a large wheel, the circumference of which is furnished, at equal distances, with levers, each bearing at its extremity a weight, and movable on a hinge, so that in one direction they can rest upon the circumference, while on the opposite side, being carried away by the weight at the extremity, they are obliged to arrange themselves in the direction of the radius continued. This being supposed, it is evident that when the wheel turns in the direction, a, b, c, the weights, A, B, and C, will recede from the center; consequently, as they act with more force, they will carry the wheel toward that side; and as a new lever will be thrown out, in proportion as the wheel revolves, it thence follows, say they, that the wheel will continue to move in the same direction. But, notwithstanding the specious appearance of this reasoning, experience has proved that the machine will not go; and it may indeed be demonstrated that there is a certain position in which the center of gravity of all these weights is in the vertical plane passing through the point of suspension, and that therefore it must stop.

Fit companions to these remarkable specimens of false reasoning are the two modern devices of which we give illustrations in Figs. 9 and 10.

Fig. 9 represents a device by Charles Batcheller, of Polk County, Iowa, on which he took out a patent during 1870.

"My invention is designed to provide a simple balance power, that may be advantageously used in connection with any machinery where a balance wheel or fly wheel is used or may be used. By my combination of levers, weights and gearing, I create a compound power that is perfectly balanced when at rest. Thus far it is similar to a common fly wheel. But less force is required to put my compound wheel in motion, and, after being started, it accumulates a greater power, and much more rapidly, than an ordinary balance wheel. The degree of power actually gained has not been accurately determined. In addition to the increase of power I gain an increase of speed. While my compound balance lever power makes one revolution, the inside shafts and wheels thereto attached make two revolutions. The illustration is a perspective view of my compound balance lever mounted on a frame. A is the frame. B represents pieces forming frames, in each of which are hung three geared wheels. There are two of these frames and two sets of these geared wheels. C is a geared wheel, which can be used for communicating power. D, belt wheels, which are also used to communicate power. These can be used at the same time, one on each side; and in place of the belt wheels and belting, geared wheels may be substituted. E represents weighted levers firmly secured to the axes of the geared wheels. There are four of these weighted levers, but only three shown in the illustration. G represents geared wheels secured on the hollow shafts, H, together with the frames, B. There are two of the geared wheels, and they are so placed that they connect the two sets of wheels and weights. By this connection the balancing power is formed. The frames, B, and the wheels, G,

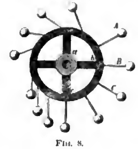


FIG. 8.

are secured upon the hollow shafts, so that they cannot move independent of each other. Shafts are placed within the hollow shafts, H, upon which the communicating wheels, D, and the center wheels are secured, so that they can move independent of the frames, B, and wheels, G. While the frames, B, make one revolution, the wheels, D, and the center wheels, make two revolutions. This is caused by the action of the weighted levers, E. Their weight, or inertia, prevents them from passing around the center of the axis of the wheels with which they are suspended in the revolving frames. The full force of this resistance, or inertia, is applied to the other wheels of each set, and by these wheels communicated to the center wheel.

"The size and weight of this compound balance lever power may be varied and adapted to the various uses to which it may be applied."

Fig. 10 is a device of Doctor Alois Drasch, of St. Egidi, Austria, patented in the United States, December 22, 1868.

"This invention consists in the arrangement of an annular tilting tray, which forms the orbit for a revolving ball, in combination with a supporting platform, and with a lever which extends into the tray and connects with a shaft, to which motion is to be imparted, in such a manner that, by continually changing the position of the tray, the ball is caused to rotate therein without interruption, and by the action of the rotating ball on the lever the desired motion is imparted to the shaft, which connects with the working machines or mechanism to be driven. A represents a tray, which forms an annular path, or orbit, for the ball, B. This tray is made of sheet metal, or any other suitable material, and its diameter is about four times that of the ball, B. It is supported in its center by a rod, which connects, by a ball and socket joint, C, with a platform, D, so that said tray can be readily tilted in any desired direction. From the edge of the platform, D, rises a circular rim, E, which prevents the tray from being tilted any lower than desirable. The position of the tray is governed by a hand lever, F, which enables the operator to con-

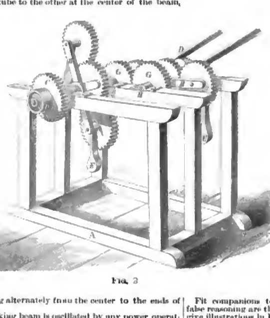


FIG. 3

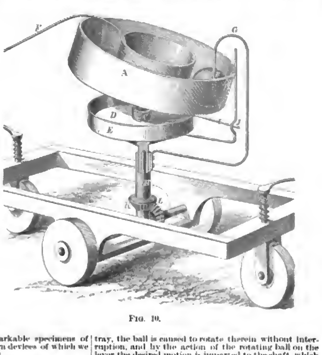


FIG. 10.

tinually tilt said tray in advance of the rotating ball, so that said ball is kept rolling on a continually changing inclined plane; and, as the ball progresses in its orbit, it bears on a lever, G, which extends from the shaft, H, into the tray, as shown in the drawing. The tray is guided in its tilting motion by an arm, I, which is firmly attached to its circumference, and catches in a loop, J, secured to the edge of the platform, D. The shaft, H, is intended to transmit the motion, imparted to it by the action of the ball, B, to the working machines, or to a mechanism of any desired construction.

"In the drawing, my motor is shown as applied for propelling a railroad car, or vehicle, and in this case the shaft, H, bears a bevel wheel, K, which gears into a similar bevel wheel, L, mounted on the axle of the car, or vehicle, so that the rotary motion imparted to the shaft, F, will be transmitted to the axle of the car, or vehicle, and the desired motion of said car, or vehicle, will be effected. It is obvious, however, that my rotary ball motor is applicable for the purpose of driving machinery of any kind, and it is particularly valuable in localities where the erection of a steam engine, or other motor, would be difficult or impracticable."

(To be continued.)

THE STOCKHOLM EXHIBITION.

A SPECIAL charm has been added the past summer to the many attractions of the beautiful Swedish capital Stockholm. In close proximity to the town, bounded on one side by the wooded slopes of the zoological garden, on the other by the extended cliffs of the Baltic, an exhibition of productions of the North spreads gay life around. But not only by its beautiful site is the exhibition distinguished. It is marked by a general excellence in the artistic and clever arrangement of its rich and interesting array of exhibits. It brings before our eyes the commerce and industry, the social life and the educational progress of a hard working people, a people which, notwithstanding its modesty, is fully conscious of its own power, and which at this exhibition proves to the world that intelligence and carefully trained talent place it on a par with the other civilized nations in the great strife of culture and industry.

Another merit of this exhibition is its freedom from those worthless shows, calculated to satisfy the tastes of a mixed public, which have lately infested many of the over-numerous exhibitions opened throughout Europe. The Stockholm exhibition has a dignified reserve which was well in keeping with the refined, industrious, national character of the Swede.

Much of the success was due to the assiduous efforts of the Crown Prince, who, as patron, not merely nominally but actively supported the enterprise. Wherever a difficulty arose his helping hand was felt, and he again found a ready counselor and supporter in his father, King Oscar II. The younger prince, too, Gustavus, himself a talented painter, paid much attention to the management of the art department of the exhibition. With such influential personages exerting all in their power toward the successful development of the undertaking, this rapidly grew in extent to an unexpected size, Denmark and Russia competing with additional zeal. When, therefore, in May, King Oscar opened the exhibition with an appropriate speech, his words were greeted with shouts of joy and cheers of applause, in honor of the Stockholm Exhibition, a completed and wonderful work, filling all with admiration for the good taste and the zeal of its promoters.

OLD STOCKHOLM.

The great variety by which this exhibition was marked shows itself already in the exterior of the buildings. These, extending over 3,900,000 square feet, differ greatly in style, all buildings being represented, from the massive Gothic and the graceful rococo to the pretty Norse wood cottages, with colored façades, harmonizing most perfectly with the picturesque surroundings.

Immediately upon entering by the main gate we are confronted by a contrast. On the right we have the somber brick built northern museum, and in front is the great central palace, raised of wood only, in charming variety, crowned with a many colored cupola,

INDUSTRIAL AND ART EXHIBITION, STOCKHOLM, SWEDEN.

which is connected to four graceful minarets by slender bridges. The whole with its delicate façade reminds us of a Hindoo temple. To these minarets elevators raise the visitors, who from the height may enjoy a view over the whole exhibition grounds, and over the grand scenery of woods and waters around, which surround the beautiful city of Stockholm, with its grand palaces and churches, its ever busy streets and squares. In the rooms of the northern museum we find departments for education, instruction, science, hygiene and domestic industry, which last finds special support and stimulus from the Swedish government.

In this department we see real wonders in woman's work: the most beautiful embroidery, often with ancient Swedish designs, painted wood carving of exquisite shape, woven carpets and curtains, lace and allied work, even furniture in peculiar shapes and colors. The work of children, too, deserves our attention, for the elder workers would never have attained their perfection, had they not learned early to use their tools and material.

The central palace holds the industrial productions of Scandinavia, Denmark, and Russia. Here, too, our interest is fanned by the great variety, for the different realms have each separate industries, of which they represent their greatest and best at this exhibition. Thus Sweden shows artistic gold, silver and steel work, besides beautiful porcelain, which equals the Danish china in its peculiar coloration and its polish. Sweden also exhibits costly furs, fine marble and granite. Norway has first wood industry, then also metal work finished with extreme care, while in Russia's array we find bronzes and enamels. These are, of course, but a few of the numberless exhibits. Norway, of course, gave special attention to the late Nansen expedition, a model of the Fram, some remaining provisions, showing that the men were not hard pressed by hunger, a few weapons and some hunting trophies of the daring explorer, such as polar bears, skins, etc., also relics, as his sealskin jacket, and his small boat and sledge, are there to remind us of his adventurous and fortunate journey north. Two of his faithful dogs, that followed him, are here to be seen stuffed.

Near these two buildings, the northern museum and the central palace, are a number of pretty pavilions, serving for various special exhibitions and for entertainments of an instructive character. Thus there is a pavilion for sport and touring, including artistic panoramas, the most exhaustive outfits for traveling, mountaineering, glacier climbing and snowshoeing, for land and water sports of every kind. Then a pavilion for chemical industries, the pavilion of the city of Stockholm, built in rococo style, and holding all that is interesting in the public and social organization of the town; very practical are the school and the ambulance arrangements, worthy of imitation the courses in housekeeping, etc., for young girls. The underground arrangement of sewers, gas mains, etc., is made plain by a vertical section reproduced in full size. With its wood carved façade turned toward the water stands the building of the Swedish-Danish fisheries. It is built in brown wood; its exhibits offer much that is of interest and novelty even to the initiated. The models of crafts serving partly for passenger and freight transport, partly for fishing, are a great attraction. To this building is attached another devoted to Norwegian fisheries, and showing of what importance this trade is to the nation. The outfits for whaling and hunting the seal are here the features of chief interest. The riches of the Swedish forests are gathered together in a pavilion, of which the log walls and moss covered roof are sufficient indication as regards its contents. Here, too, a fine panorama supplements the well arranged collection, as also in the biological museum close by, which has been located in a quaint old peasant's cottage. This in itself is quite a curiosity. In it we see the great variety of animals found in Scandinavia represented by exquisitely stuffed specimens. Then, rising upon a neighboring hill, stands the pavilion of the Royal Hunting Club, whose president is the Crown Prince, and by whose members a considerable portion of the exhibits were secured. A little farther we come to the shining white exhibition of Swedish music and drama, with many historical memorials and a large concert hall. Here the compositions of the most eminent of Swedish masters of this century are rendered by first class musicians.

Along the banks of the Djurgarden-Vaken old Stockholm extends with its walls and turrets, its ramparts and ditches, defended by a number of quaintly shaped weapons, erstwhile perilous to the enemy, and guarded by martial looking lansquenets in the becoming uniform of the days of Gustavus Adolphus. This model of ancient Stockholm, with its narrow, crooked streets, full of antique houses, with workshops and inns, a church and the city hall, is one of the most perfect productions of its kind ever seen. In none of the representations of old towns used at exhibitions upon so many occasions within the last decade was the visitor so impressed by a feeling of reality as here. Not only is the whole construction kept very true to nature and history, but the gable houses are built of solid material, and touch us with a homely feeling, calling to memory the days of long ago. Close to the water, on a large scale, is built the old royal castle, the "Tre Kroner." Within its castle yard it is easy to fancy one's self back to past centuries, for everything here is in wonderful harmony, making one forget the present: the surrounding ramparts, with their narrow drawbridges, the castle yard with its low outlets to prison den like vaults, the staircases to the inner halls and chambers, and, lastly, the view from the porch over the market place, which in days gone by resounded on many an occasion with the clash of arms and the battle cry.

To-day peace reigns over the land. Sweden, once the home of such great warriors as Gustavus Adolphus, is now friendly to the neighboring states. But that it is able in the case of need to make a stand for liberty we are convinced when we visit the white palace of the navy and army department. This stands in the second western part of the exhibition, and the strength of Sweden by land and by water is here clearly demonstrated. We are made acquainted with the internal organization of the army and navy, and we are shown what a stress is laid by the government on the mental and physical development of the people. In lifelike groups the various army divisions are placed before us. The uniforms are becoming and practical, the officers and soldiers are marked by their modest bearing. The artillery is represented in particular completeness, partly here and partly in the pavilion for iron and steel industry. By models the rapid development of the Swedish navy is graphically demonstrated.

From the very water's edge extends the great machinery hall, built solely of glass and iron, and behind it, on a higher level, the white building of the art gallery, where nearly all nations of Europe were represented. But one of the most interesting exhibits is stationed close by, the great steel-built steamer Södra Sverige, which sank in the "Schären" (cliffs), in 1895, on the journey to St. Petersburg, and lay for nearly two years at a depth of some two hundred feet, to be raised to the surface again quite lately by an ingenious device, the invention of the engineer Waller, and to be brought to the exhibition by steam. When the boat, which is worth some $125,000, has undergone some further repair, it will again be quite seaworthy. One more item must be mentioned before we close our account of this exhibition—that is the Skansen, a thing unique in its kind, a national museum in openair. Overshadowed by gigantic northern trees, there are collected here a number of peasant cottages, which have been transported hither with inhabitants and all their domestic utensils and furniture from the various parts of the land, giving us a perfectly true picture of Swedish country life. The Skansen was founded by Prof. Hazelius at the beginning of this decade, and has since prospered, increasing visibly from year to year, owing to vivid interest taken in its welfare.

The exhibition was held in honor of the twenty-fifth anniversary of the present king's coronation. No better or more worthy gift could the nation have brought its ruler, for by it is shown the progress in all branches of industry which has attended the peaceful reign of the monarch, and no mean compliment is thus paid with great delicacy to King Oscar II, of Sweden.

The illustrations accompanying our article are from Ueber Land und Meer.

THE NEW RUSSIAN CHURCH IN KARLSBAD.

THE NEW RUSSIAN CHURCH AT KARLSBAD, BOHEMIA.

A FEW weeks ago Karlsbad saw the inauguration of a Greek Catholic church. The new building does not only fill a long felt want in that much frequented summer resort, but it also figures highly among the great architectural sights of the city. The erection of a Greek Catholic church for the use of the Russian guests had long been contemplated. In 1866 Washington House, a building in the Marienbaderstrasse, was purchased, and by the work of the architect Mayblum transformed into a hall for religious services. But soon its capacity was found insufficient for the growing number of visitors. A piece of land on the Parkstrasse was bought as a site for a new church, the funds being partly presented by Russian guests who had sought and found health at Karlsbad, and partly granted by the Russian ministry, and by Pobjedonoszew, the procurator of the holy synod. Thanks to further donations the foundation stone could at last be laid on July 11, 1893. The plan of the church was designed in the Russo-Byzantine style of the eighteenth century by the architect Wiedermann, of Franzensbad. The forthcoming funds enabled the architect to set to work with such decision that on June 9 the building was ready for consecration. At this celebration the prior of the Kasan Church, St. Petersburg, assisted by archdeacons from Vienna, Budapest, Dresden, and Wiesbaden, performed the festal rites, whereupon the actual consecration was conducted by the Archdean Apraxin, the ecclesiastical head of the orthodox community of Karlsbad. The church was dedicated to St. Paul and St. Peter.

The building stands on a terrace which rises from the upper part of the Parkstrasse, a flight of steps leading up into the church from that street forming the main entrance. The roof is crowned with one central cupola of peculiar onion shape and a number of smaller ones of the same structure, grouped around it. One of these smaller cupolas forms the top of a pointed steeple in the back of the building. The walls are externally decorated by frescoes representing Christ crucified, and the two apostles to which the church is dedicated. The fine sculptures with which the interior of the church is adorned were fashioned by the artist Watzek, of Fischern.

The Czar showed his interest in the newly erected church by sending the secretary of the embassy at Vienna to represent him at the consecration services, and by decorating with medals the masters who directed the construction, a few of those who by donations and otherwise helped the enterprise being also similarly favored.

We are indebted for our reproduction of the building to Illustrirte Zeitung.

THE SUBSISTENCE QUESTION IN THE KLONDIKE REGION.

THE situation in the Klondike region is in some respects similar, as regards subsistence, to the situation that existed in the Selkirk Range, west of the Rockies, in the winter of 1884-85, prior to the construction of the Canadian Pacific Railway. The end of the track of the railroad (corresponding to the end of water transportation at Dyea) was on the west slope of the Rockies, in the Kicking Horse Valley. Some 50 miles beyond lay the Selkirk Range, which the railroad was to cross at an elevation of about 4,000 ft. above sea level. This range had the name of being one of the most difficult ranges in the Northwest to cross even in summer and on foot. It was covered with fallen timber of great size, trees of eight and ten feet diameter sometimes lying two or three deep. No feed grew there for pack animals,

except for a few weeks and in a very few places. The slopes of the valleys of the Beaver and Illecillewaet Rivers were marked with traces of hundreds of snowslides. The Indians of that region could never be induced to cross the range after October. The old guides, returning eastward from the range in October, insisted that the snowslides would destroy any parties sent in there in the winter. The average yearly snowfall on the upper part of the Selkirk Range is twenty-five feet, giving from eight to ten feet depth of settled snow on the level.

A pack trail had been completed across the range by the fall of 1884, and the wagon road had been advanced part way up the east slope of the range. In October orders came from Montreal to attempt at least some parts of the work on the range. These were the heavy work intended to be built at the Albert Cañon on the west slope; the completion of the wagon road across the range to a connection with the road from the west, and the forcing in of supplies over the route as far as possible. The writer was ordered to take charge of the advance work on the west slope, and to see that ample supplies were taken in, for which work abundant pack trains were provided.

In any such country the question of feed for the animals is the limiting factor. If the country produces this, supplies can be transported an indefinite distance. If no feed is found growing there, in a few days the animals will "eat the packs off their backs," delivering nothing beyond. Therefore, the advance of the wagon road is necessary, over which many times as much per animal can be transported. This was accomplished on the Selkirk Range, so that by the end of December ample supplies had been placed at winter quarters on the west slope. After that the wintering was accomplished in comfort—in tents for much of the winter and later in cabins. With abundant supplies, temperatures of −40° F. were not severely felt; and doubtless the low temperatures which appear to be so threatening in the Klondike region will be endured in similar comfort by those who have supplies. A duck tent of single thickness could be made warm enough by a sheet iron box stove of ordinary size. In the Klondike, as elsewhere, it will probably be a problem of food rather than of temperatures. The papers made the same terrifying predictions about the Selkirk cold that are now being made about the Klondike cold. In the Portland Oregonian, which I received via Winnipeg while on the Selkirks, the statement was made that human life could not stand the intense cold of a winter in such a region. I read that paragraph in the dead of winter in my cabin on the Selkirks, in an upper room without a fire, and with my coat thrown off because of the excessive heat from the rooms below. There is no cold which cannot be comfortably met by the man who has ample supplies of food and moderate supplies of fuel and clothing, even if his shelter be very inferior. With such supplies, the cold weather in most cases will be found a tonic to the system. It is not a question of the cold or of the snows, but of transportation.

The construction of the Selkirk wagon road was continued westward during the winter, and the road was connected with the road from the west in December. Temperatures of −35° F. were experienced during this construction, but did not stop the work. Such a wagon road is made largely by clearing and grubbing, with moderate amounts of earthwork, and some rockwork at peculiarly difficult points. The small proportion of earthwork permits the work to go forward, the work other than earthwork being readily done in cold weather. For a road to be used chiefly for sledding, and where heavy snows are expected, the grubbing may be very much reduced.

The winter time, which is being pointed to as the obstacle to advancement into the Klondike region, is really just the time to make such an advance by the overland route, if that advance be properly organized and pushed. In transportation, as in logging, winter is the time for work. Sleds will carry much greater loads over the snow than wagons will take later on rough roads. The snow slides caused only temporary interruption on the Selkirk Range. The slides that went far below the wagon road (or "tote road," as it is termed) left in general only moderate amounts of snow on the road. The slides which came to rest near the road, leaving a great depth of snow on the road, did not permanently interrupt travel. The snow was soon packed hard enough for teaming to be done over it as usual. It is stated that east of the Chilkat Pass, the winter snowfall is only about three feet; the topography of the country is not such as to create many large slides.

On the Rockies and Selkirks there were a few gradients, adverse to the haul of twenty feet per hundred, the difficulties being massed where helpers could be used readily. The Chilkat Pass, altitude 3,500 feet, shows eleven miles on one slope and ten miles on the other, or more than sufficient sustaining ground to give reasonable gradients for a wagon road, without deviation of route.

In attempting a comparison of the Klondike overland route with the Selkirk transportation, we are at a disadvantage, owing to the variations in miners' estimates of distances. Approximately the route appears to be as follows:

Dyea to head of navigation	6	miles
Southwest slope of Chilkat Pass	11	"
Northeast " " " "	10	"
On Lake Linderman	8	"
Portage	1	"
On Lake Burnett	26	"
Portage and Caribou River	3	"
On Lake Tagish	17	"
Portage to Marsh Lake	3	"
On Marsh Lake	24	"
On White Horse River to the rapids	27	"
" " " " below the rapids	30	"
On Lake Le Barge	31	"
On Lewis River	62	"
By land to Fort Selkirk (at the junction of the Lewis and Pelly Rivers, forming the Yukon River)	200	"
Total to the Yukon	459	"

Thence down the Yukon and up its tributaries by boat from 100 to 150 miles, according to the location of the mine or claim. As ten or a dozen claims would take up a mile of river under the old regulations, and as there are several thousand men already holding claims, a statement as to how far a man may have to go to reach his journey's end is necessarily an elastic affair by 50 or 100 miles. The last 25 or 50 miles would probably be on land. (The 200 miles of land travel to Fort Selkirk is given by some miners; others appear to travel this distance by boat.)

The Klondike overland route thus includes three important stretches of land travel, namely, at the Chilkat Pass, at the portion before Fort Selkirk is reached, and at the terminus of the journey. The first two stretches are traveled by all, and are a matter for public improvement; the last stretch will probably be a matter for packhorse work by the individual miner. The public route, with the exception of the first two stretches of land travel, is one affording a natural road in winter of the best sort of sledding, on frozen lakes and rivers, with a few short places requiring improvement. The blockade of which we hear most is that of the Chilkat Pass, where great numbers of men en route appear to be lying idle, awaiting the few Indian packers who are available, and who are charging from fifteen to twenty-five cents per pound for packing the twenty-seven miles to Lake Linderman. Thence the route is by boats, poor affairs made on the ground out of green whip-sawed lumber. This mode of transportation was attempted on the Columbia River, east of the Selkirks, where the rapids were much less formidable than the Northwestern Rapids are reported to be; but even the deep mud of the wagon road in spring was preferred by all but half a dozen parties. Anyone who has felt the power of water in the rapids of a mountain stream is apt to have too much respect for it to select such a transportation route if any other can be found.

We hear but little of the blockade at the stretch of land travel before Fort Selkirk is reached. It may be more serious than the Chilkat blockade, being further from feed or horses and from the large body of packers, or this stretch may be covered by boat by most of the parties. Some of the writer's acquaintances in the West are arranging to use both horses and dogs, the former at the Chilkat Pass, the latter in the later journey; the horses being killed for dog meat after the Chilkat transportation is completed. But dogs cannot be procured in sufficient numbers to meet the great demands of the situation. The probability is that the great mass of supplies will be transported to the Klondike region by winter transportation. Can this be done?

The difficulty of doing this by pack animals can be readily shown. Allowing only 20 pounds of feed per day per pony, and a load of 240 pounds per animal, in 12 days the pony has "eaten his load off his back," and must then be left to die, with no surplus delivered and nothing accomplished. This is just what happened in cases on the Selkirk Range, before the wagon road had been advanced; dead ponies were numerous along the trail. To place even 100 pounds per animal at the mines, a pack train must make the journey in less than seven days. The journey, even with the aid of water transportation, now takes over three times that length of time. In winter it has been known to take over 60 days.

On the other hand, assuming that a sled and team can take 3,000 pounds over a good sled road to the mines in about 20 days, we have about 800 pounds of the load consumed by the team and 2,200 pounds delivered. This is about a year's supply for a miner.

The weak point in the present situation appears to be the disorganized, individual character of the efforts to enter the country. At Dyea over 3,000 men are now said to be lying idle, awaiting packers. A tenth part of this number could construct a sled road across the Chilkat Pass in a few weeks, even if much rock work had to be done. No more provisions would be consumed by them than while lying idle. The Indian packers are too few to oppose effective resistance to such a construction; and the Pacific Coast Indian is not of the right make-up for a fight. There is a report that a company is being formed at Juneau to improve the transportation arrangements. A few weeks of work west of Fort Selkirk would probably secure a sled road at that stretch of land travel. For the rest of the distance, the winter will make the sled road. The eagerness to get to the mines this summer will probably prevent a proper combined effort until fall shows the blockaded parties the need of organized effort. Those who force their way in after August will reach the mining region poorly provided with supplies, worn out by their efforts to get in, and too late to prospect before snow. Those who go more deliberately and intelligently, after aiding in the construction of a sled road, will arrive in comparative comfort, better provided with supplies, with ample time in the winter to make a good general selection of country in which to seek a claim; and they will be on the ground before the arrivals by boat on the Yukon. If there be only three feet of annual snowfall in the Yukon country, as reported, there may be more wind than is generally experienced in regions of heavy snow, the latter being generally windless in winter. Continuous sledding, which the large travel will secure, will overcome this difficulty and keep the road open. The possibility of delivering supplies by vessels in the Yukon region part of the year is an obstacle to the construction of a good overland sled road, as is also the prospect of a railway route, both of these routes making the sled road a temporary affair.

The cost of a wagon road in mountain country, similar to the Selkirk Range, with wages, not including board, $1.75 per day, may be taken at $1,800 per mile maximum, with a rate as low as $100 per mile on fairly level easy stretches, and at locations about 150 miles from the base of supplies. If there be only 3,000 tons to be transported, and if only twenty cents per pound be saved by the construction of 250 miles of sled road, the economy of its construction can readily be calculated. For men en route with their supplies, a rate of $1.75 per day would be a good figure, as they would probably work for the cost of their subsistence, in order to save their own stores of food.

Sleds are readily made in the woods by an expert woodsman with ax and auger. I have had one made in a half day that would carry a ton. To handle 4,000 tons, including feed, several thousand horses would have to be shipped to Dyea, if the horses were to be sold at the mines, making no additional trips. With probably five round trips possible, a much smaller number would answer, depots of supplies of feed being established for the return trips.

Those who rely upon making an early entrance by the land route into the Klondike region after the streams are open for boating will probably make a mistake. The break-up in these upper tributaries of the Yukon will occur much later than in the lower Yukon, and vessels will probably reach Dawson City before the upper streams on the overland route have subsided from the freshets and have become navigable safely. In the late spring the ice will become rotten and an interval of cessation of transportation occur. The road will be neither sled road nor wagon road for a time under the melting snow and the spring rains. The late spring for the overland route must be the worst possible time, judging from experience elsewhere. The winter may be found the best possible time under proper organization and with proper effort.—Archibald A. Schenck, in the Railroad Gazette.

[Continued from SUPPLEMENT, No. 1130, page 18067.]

EDWARD DRINKER COPE, NATURALIST.*

THE studies of Cope on those classes which had earliest attracted his attention were more nearly completed than for any others. Many years ago he had contemplated the publication of monographs of the amphibians and reptiles of North America and happily he had at last finished his work.

In 1889 his monograph of the "Batrachia of North America" was given to the world as a Bulletin of the United States National Museum (No. 34). It forms a goodly volume of 525 pages illustrated by 84 plates† and 120 figures inserted in the text. No large country has a more elaborate and scientific exposition of the class than is given in this volume. A synopsis is furnished of all the families and genera wherever found, and detailed descriptions are supplied for all the groups and species represented in the zoological realm of North America; 31 genera and 107 species are recognized, and of these Cope had first made known about a quarter, 7 of the genera and 27 of the species having been described by himself. Shortly before his death, and during his last visit to Washington, he delivered to the National Museum the report on all the reptiles of North America which he had been long preparing. This was prepared on the model of his "Batrachia of North America," but will, of course, be a much larger work, inasmuch as there are nearly three times as many reptiles as Batrachians.‡ His last elaborate memoirs dealt with special anatomical features of the serpents and lizards, which he examined with the view of perfecting the system of those groups.

IV.

In 1864 he became especially interested in the fresh water fishes of the United States, and then, as well as in succeeding years, published enumerations and descriptions of many species. His first papers in 1864 and 1865 were "On a Blind Silurid from Pennsylvania" and a "Partial Catalogue of the Cold Blooded Vertebrata of Michigan;" in 1868 he published "On the Distribution of Fresh Water Fishes in the Allegheny Region of Southwestern Virginia," and in 1869 appeared a "Synopsis of the Cyprinidæ of Pennsylvania." In addition to these, various minor papers were published, and in some of them marine forms were considered.

When in Europe Cope had purchased a large collection of skeletons of fishes from all parts of the world prepared by Prof. Joseph Hyrtl, of Vienna, one of the most skillful practical anatomists of the day. He had a number of other skeletons made to represent missing types. With these as a basis he proceeded to recast the classification of fishes. The first contribution to the subject was embodied in an introductory chapter of his "Contribution to the Ichthyology of the Lesser Antilles," published early in 1871.

The same chapter, with the same title, "Observations on the Systematic Relations of Fishes," but with some modifications and additions, was later published in the Proceedings of the American Association for the Advancement of Science for 1871. This was a notable paper and replete with original observations of value. It was not, however, up to the standard of his work on amphibians and reptiles. The subject, indeed, was too vast and only a superficial examination was made of special parts. It was not a classification based on the examination of the entire structure, but rather an exposition of the development of a few particular characters, which more experience subsequently convinced him were of less value than he had supposed. Nevertheless, in some respects the proposed classification was much in advance of those previously adopted, and useful hints were given for the further improvement of the system.

Later Cope followed up this attempt at the reformation of the ichthyological system with several others especially treating of extinct types. One of them, "On the Classification of the Extinct Fishes of the Lower Types," was published in the Proceedings of the American Association for 1877. The results of his studies were summarized, in 1889, in "A Synopsis of the Families of Vertebrata," and two years afterward (1891) with modifications, in an article "On the Non-actinopterygian Teleostomi." These results were very valuable and attention was for the first time directed to the importance and morphological significance of the skeletal fin structures of the ancient fishes long confounded under the name of Ganoids. Instead of this single order (or sub-class) of the old systematists, he named four superorders of the Teleostomi or true fishes, and recognized seven orders, including the old Ganoids after eliminating the Lepidosteids and Amiids, which were referred to the Actinopterygians. Only two of the seven orders are represented by existing forms—one (Cladistia) by the bichirs of Africa and the other (Chondrostei) by the sturgeons.

His work on the extinct fishes was incomparably better than any that had been done before in the United States. He far surpassed all his predecessors, not only by his knowledge of morphological details manifest in the extinct as well as living forms, but by

* Presidential address by Prof. Theodore Gill before the annual meeting of the American Association for the Advancement of Science, August 9, 1897.

† The last plate is numbered 89, but five were canceled—80, 81, 82, 84 and 85.

‡ Cope's monograph of the reptiles will not include the tortoises, those having been left to Dr. G. Baur to monograph.

his keen philosophical instinct and taxonomic tact. But this philosophical instinct was sometimes at fault, and occasionally he indulged in the wildest speculations, for which he has, not unjustly, been taken to task. But even his blunders were the result of the facility of his mind in seizing and adapting the latest utterances of science.

One notorious case may be given. The great Russian embryologist, Kowalevsky, published a memoir sustaining the thesis that the Tunicates were members of the vertebrate phylum and that the larval stage of most of the species had the homological equivalent of the backbone of the true vertebrates. Cope foresaw the morphological consequences of this view and sought the vertebrates nearest the Tunicates. He settled upon some strange forms of the Silurian and Devonian times known as Pteraspids and Cephalaspids. They were the earliest known of vertebrates and therefore likely to be the most primitive in structure. Most of them had a shell-like encasement, composed of bone-like plates. He happened to find illustrations of the living Chelyosoma, a true Tunicate having a system of plate-like indurations of the integument, somewhat similar in appearance to those of some of the ancient fishes. It was assumed that this mere superficial similarity indicated genetic relationship. To those acquainted with the structure of Chelyosoma this approximation seemed strange indeed; its anatomy was known and the form is simply a well marked relation of the typical ascidians, but highly specialized by the development of integumentary plate-like horny indurations. Histologically and otherwise they were very different from the plates of the extinct armored vertebrates. Cope's guess was simply the result of the tendency to jump at conclusions which he was constantly obliged to curb, and unfortunately he rushed into print before he had time to think. He soon reconsidered the case with cooler mind, and abandoned his hypothesis. Few men were ever more willing to reconsider evidence and retrace false steps than he.

In spite of errors of detail and somewhat hasty generalization the ichthyological labors of Cope were unusually valuable contributions to science, and the progress of ichthyology has been much accelerated, not only by these labors, but by the investigations they challenged.

V.

Cope's attention was early drawn to the mammals. His first published article (1863) was a description of a supposed new shrew found in New Hampshire, and in 1865 he described various cetaceans. In 1868 he began the collection and investigation of the fossil mammals of the Western territory, and thenceforward devoted the larger share of his attention to the description and restoration of the numerous new species which he from time to time brought to light. The previous investigators of the extinct mammals of America had almost exclusively confined themselves to descriptions and illustrations of the crania and dentition, but a new era was introduced when Marsh and Cope sent out exploring expeditions or themselves collected. No parts of skeleton were neglected; all were collected. Gradually the numerous bones from different parts of the skeleton were identified, and finally many of the beasts of old were resurrected into skeletons almost as complete as those just divested of muscles.

The discoveries resulting from such thorough work quite modified or even overturned old conceptions. It became evident that there was a great contrast between the development of the mammals and that of invertebrates, and even, though in a less degree, of fishes. It appeared that there was a much more rapid process of evolution for the mammals than for the lower classes. All the mammals of the oldest of the Tertiary periods were strange and very unlike those of recent times, and no descendants of even the same families lived to be the contemporaries of civilized man. The views of the founder of vertebrate paleontology were also to a considerable extent subverted. Cuvier taught that there was always a co-ordination between the various systems of the animal frame and that from the remains or impress of one part the approximate structure of the other parts could be inferred. He even pushed this doctrine to such an extreme that he overlooked some obvious counter facts. One such case is so remarkable because it originated with Cuvier and was indorsed by Huxley* that it is worthy of mention here, and Huxley's introduction to it and translation of it may be given. Huxley himself protests against the too literal application of Cuvier's law and recalls Cuvier's own reserve:

"Cuvier, the more servile of whose imitators are fond of citing his mistaken doctrines as to the nature of the methods of paleontology against the conclusions of logic and of common sense, has put this so strongly that I cannot refrain from quoting his words.†

"But I doubt if any one would have divined, if untaught by observation, that all ruminants have the foot cleft, and that they alone have it. I doubt if any one would have divined that there are frontal horns only in this class; that those among them which have sharp canines for the most part lack horns.

"However, since these relations are constant, they must have some sufficient cause; but since we are ignorant of it, we must make good the defect of the theory by means of observation. It enables us to establish empirical laws, which become almost as certain as rational laws, when they rest on sufficiently repeated observations; so that now, whoso sees merely the print of a cleft foot may conclude that the animal which left this impression ruminated, and this conclusion is as certain as any other in physics or morals. This footprint alone, then, yields to him who observes it, the form of the teeth, the form of the jaws, the form of the vertebræ, the form of all the bones of the legs, of the thighs, of the shoulders, and of the pelvis of the animal which has passed by. It is a surer mark than all those of Zadig."

The first perusal of these remarks would occasion surprise to some and immediately induce a second, more careful reading to ascertain whether they had not been misunderstood. Some men, with much less knowledge than either Cuvier or Huxley, may at once recall living exceptions to the positive statements as to the co-ordination of the "foot cleft" with the other characters specified. One of the most common of domesticated animals—the hog—would come up before the "mind's eye," if not the actual eye at the moment, to refute any such correlation as was claimed. Nevertheless, notwithstanding the fierce controversial literature centered on Huxley, no allusion appears to have been made to the lapsus. Yet every one will admit that the hog has the "foot cleft" as much as any ruminant, but the "form of the teeth" and the form of some vertebræ are quite different from those of the ruminants, and of course the multiple stomach and adaptation for rumination do not exist in the hog. That any one mammalogist should make such a slip is not very surprising, but that a second equally learned should follow in his steps is a singular psychological curiosity.

I need scarcely add that the law of correlation applied by Cuvier to the structures of ruminants entirely fails in the case of many extinct mammals discovered since Cuvier's days. Zadig would have been completely nonplussed if he could have seen the imprint of an Agriochœrid, a Uintathœrid or a Menodontid.

I have given this quotation for two reasons: first, to indicate how the increase of our knowledge has revolutionized old conceptions; and second, to show how even the ablest of men may stumble.

Cope has been much criticised for the mistakes and false generalizations he made. Unquestionably he did make many. But error seems to be inseparable from investigation, and if he made more than the other great masters, he covered more ground and did more work. He was also, it must be admitted, more hasty than some others, in that he availed himself of the more frequent means of publication he enjoyed.

The great merit of Cope's work on mammals is that he always considered the old and new—the extinct and recent—forms together. He refused to be bound by consistency or by precedent, either set by himself or others. Fresh discoveries opened new vistas to him, and he modified his views from time to time and as often as he received new evidence.

He introduced many new families in the system and sought to improve the system by the comparison of all the elements of the skeleton. He came to the conclusion that the affinities of the ungulate quadrupeds was best expressed by the manner of articulation of the bones of the carpus and tarsus; he associated those having the "carpal and usually tarsal bones in linear series" in a great order which he called Taxeopoda, and contrasted them with the Proboscidea and typical Ungulata, which he named anew Diplarthra. In the Taxeopoda he gathered many extinct families and associated with them forms of the existing fauna known as the Hyracoidea, Daubentonioidea, Quadrumana and Anthropomorpha. I cannot altogther assent to this collocation, inasmuch as I think the common characteristics of the three groups last mentioned—especially the structure of the brain and the development of the posterior cornua of the ventricles as well as calcarine sulci—justify the old order Primates. Nevertheless an important character was first appreciated in the composition of the podial bones, and fresh insight was obtained into the relations of ancient types.

I can only name a few more of Cope's discoveries in this connection. One was the generalization of "trituberculy," or the original development of three tubercles to molar teeth, and that subsequent modifications of the corresponding teeth were based on this original plan. Another was the remarkable Phenacodus of the Eocene, which was considered to be nearly in the line of descent for the ungulates as well as the series culminating in man and which led him to the conception of the taxeopodous group.

The past history and genealogy of the camels and their relations were likewise elucidated. In the present epoch only two nearly related types exist separated by half the globe—the true camels of central and northern Asia and the llamas of the Peruvian Andes. Cope revealed numerous species from various Tertiary beds and showed that the type was originally richly developed in America.

VI.

Paleontology from more than one point of view may be divided into Invertebrate and Vertebrate. The subjects of the former are generally to be found in an approximately complete condition so far as the exterior is concerned, and early attracted the attention of investigators, often little familiar with recent zoology, and received names. The subjects of the latter—especially the higher types, as mammals, birds and reptiles—are rarely found, except in a fragmentary condition. Special knowledge of osteology, even to its minutest details, is requisite to successfully deal with such remains. Consequently the fossil vertebrates of the United States were neglected and left to the few who had cultivated the requisite knowledge to deal with them.

Another reason existed for the tardy attention to Vertebrate paleontology, which continued till nearly the last quarter of our present century in the United States. No deposits containing many fossil vertebrate remains had become known in the East. Zoologists interested in the past and in the genealogy of existing forms lamented the poverty of the United States, which contrasted with the richness of some parts of Europe. It was even thought that there was no hope of finding here such trophies of the past as the beds of the Paris Basin or those of Grecian Pikermi had yielded to European paleontologists. But all this was to be changed. Rumor had long before hinted that numerous skeletal remains could be found in certain parts of the wild West, but the information was very vague. Enough was known, however, to induce Prof. Marsh to visit certain deposits he had heard of. In 1870 he explored an Eocene lake basin in Wyoming, drained by the Green River, the main tributary of the Colorado, and therein found numerous bones belonging to almost all parts of the skeleton of some remarkable gigantic mammals which he called Dinocerata. The results of this exploration interested Cope in the highest degree. He visited the same region in 1872, and thenceforth his attention to the Vertebrate paleontology of the Western States and Territories was never interrupted. An intense rivalry arose between Prof. Marsh and himself which in time, it must be confessed, became very bitter. Nevertheless, as in most quarrels respecting facts, investigations were provoked by mutual recriminations which resulted in a more speedy accumulation of data and a more critical examination of these data than would have been likely under less perturbed conditions. Most of those data relate to morphological and anatomical considerations, and therefore belong rather to mammalogy and herpetology than to geology.

The relations of the ancient forms to each other in point of time; to those of other lands, and to those whose remains were embedded in other rocks had necessarily to be investigated. The earliest conclusions of Cope were brought together and published in 1879 in a memoir on "The Relations of the Horizons of Extinct Vertebrata of Europe and North America."* He attempted therein to synchronize, or, rather, homotaxially correlate the various ancient fauna of North America and "West Europe" from the "Primordial" to the "Pliocene." Naturally the greater part of the memoir was devoted to the consideration of the Tertiary divisions; of these he admitted for the American form six primary divisions, and four of these were dichotomously subdivided for the time. Of the primary divisions three were referred to the Eocene, one (White River) to the Oligocene, one (Loup Fork) to the Miocene, and one to the Pliocene. The exposition thus made represents views not very different from those now held, although, of course, modifications in details have since been necessary.

The evolution of the various animal, and especially mammalian types, was also continually the subject of Cope's researches, and he attempted to trace the passage from those of the most ancient periods to those of later ones.

(To be continued.)

ADDRESS BY SIR JOHN EVANS,

K.C.B., D.C.L., LL.D., Sc.D., Treas. R.S., V.P.S.A., For. Sec. G. S.; Correspondant de l'Institut de France, etc.; President of the British Association for the Advancement of Science.†

ONCE more has the Dominion of Canada invited the British Association for the Advancement of Science to hold one of the annual meetings of its members within the Canadian territory; and for a second time has the association had the honor and pleasure of accepting the proffered hospitality.

In doing so, the association has felt that if by any possibility the scientific welfare of a locality is promoted by its being the scene of such a meeting, the claims should be fully recognized of those who, though not dwelling in the British Isles, are still inhabitants of that Greater Britain whose prosperity is so intimately connected with the fortunes of the mother country.

Here, especially, as loyal subjects of one beloved sovereign, the sixtieth year of whose beneficent reign has just been celebrated with equal rejoicing in all parts of her empire; as speaking the same tongue, and as in most instances connected by the ties of one common parentage, we are bound together in all that can promote our common interests.

There is, in all probability, nothing that will tend more to advance those interests than the diffusion of science in all parts of the British Empire, and it is toward this end that the aspirations of the British Association are ever directed, even if in many instances the aim may not be attained.

We are, as already mentioned, indebted to Canada for previous hospitality, but we must also remember that, since the time when we last assembled on this side of the Atlantic, the Dominion has provided the association with a president, Sir William Dawson, whose name is alike well known in Britain and America, and whose reputation is indeed world wide. We rejoice that we have still among us the pioneer of American geology, who among other discoveries first made us acquainted with the "Air Breathers of the Coal," the terrestrial or more properly arboreal saurians of the New Brunswick and Nova Scotia coal measures.

On our last visit to Canada, in 1884, our place of assembly was Montreal, a city which is justly proud of her McGill University; to-day we meet within the buildings of another of the universities of this vast Dominion—and in a city, the absolute fitness of which for such a purpose must have been foreseen by the native Indian tribes when they gave to a small aggregation of huts upon this spot the name of Toronto—"the place of meetings."

Our gathering this year presents a feature of entire novelty and extreme interest, inasmuch as the sister association of the United States of America—still mourning the loss of her illustrious president, Professor Cope—and some other learned societies, have made special arrangements to allow of their members coming here to join us. I need hardly say how welcome their presence is, nor how gladly we look forward to their taking part in our discussions, and aiding us by interchange of thought. To such a meeting the term "international" seems almost misapplied. It may rather be described as a family gathering, in which our relatives more or less distant in blood, but still intimately connected with us by language, literature and habits of thought, have spontaneously arranged to take part.

The domain of science is no doubt one in which the various nations of the civilized world meet upon equal terms and for which no other passport is required than some evidence of having striven toward the advancement of natural knowledge. Here, on the frontier between the two great English speaking nations of the world, who is there that does not inwardly feel that anything which conduces to an intimacy between the representatives of two countries, both of them actively engaged in the pursuit of science, may also, through such an intimacy, react on the affairs of daily life, and aid in preserving those cordial relations that have now for so many years existed between the great American republic and the British Islands, with which her early foundations are indissolubly connected? The present year has witnessed an interchange of courtesies which has excited the warmest feelings of approbation on both sides of the Atlantic. I mean the return to its proper custodians of one of the most interesting of the relics of the Pilgrim Fathers, the log of the Mayflower. May this return, trifling in itself, be of happy augury as testifying to the feelings of mutual regard

* Huxley, "Introduction to the Classification of Animals," 1869, in first chapter "On Classification in General."

† Ossemens fossiles, ed 4me tome i, p. 184.

* Bull. U. S. Survey Terr., v, 33-54.

† Delivered at Toronto, August 18, 1897.

and esteem which animate the hearts both of the donors and of the recipients!

At our meeting in Montreal the president was an investigator who had already attained to a foremost place in the domains of physics and mathematics, Lord Rayleigh. In his address he dealt mainly with topics, such as light, heat, sound, and electricity, on which he is one of our principal authorities. His name and that of his fellow worker, Professor Ramsay, are now and will in all future ages be associated with the discovery of the new element, argon. Of the ingenious methods by which that discovery was made, and the existence of argon established, this is not the place to speak. One can only hope that the element will not always continue to justify its name by its inertness.

The claims of such a leader in physical science as Lord Rayleigh to occupy the presidential chair are self-evident, but possibly those of his successor on this side of the Atlantic are not so immediately apparent. I cannot for a moment pretend to place myself on the same purely scientific level as my distinguished friend and for many years colleague Lord Rayleigh, and my claims, such as they are, seem to me to rest on entirely different grounds.

Whatever little I may have indirectly been able to do in assisting to promote the advancement of science, my principal efforts have now for many years been directed toward attempting to forge those links in the history of the world, and especially of humanity, that connect the past with the present, and toward tracing that course of evolution which plays as important a part in the physical and moral development of man as it does in that of the animal and vegetable creation.

It appears to me, therefore, that my election to this important post may, in the main, be regarded as a recognition by this association of the value of archeology as a science.

Leaving all personal considerations out of question, I gladly hail this recognition, which is, indeed, in full accordance with the attitude already for many years adopted by the association toward anthropology, one of the most important branches of true archeology.

It is no doubt hard to define the exact limits which are to be assigned to archeology as a science and archeology as a branch of history and belles lettres. A distinction is frequently drawn between science on the one hand and knowledge or learning on the other; but translate the terms into Latin, and the distinction at once disappears. In illustration of this I need only cite Bacon's great work on the "Advancement of Learning," which was, with his own aid, translated into Latin under the title "De Augmentis Scientiarum."

It must, however, be acknowledged that a distinction does exist between archeology proper and what, for want of a better word, may be termed antiquarianism. It may be interesting to know the internal arrangements of a Dominican convent in the middle ages, to distinguish between the different mouldings characteristic of the principal styles of Gothic architecture; to determine whether an English coin bearing the name of Henry was struck under Henry II, Richard, John, or Henry III, or to decide whether some given edifice was erected in Roman, Saxon, or Norman times. But the power to do this, though involving no small degree of detailed knowledge and some acquaintance with scientific methods, can hardly entitle its possessors to be enrolled among the votaries of science.

A familiarity with all the details of Greek and Roman mythology and culture must be regarded as a literary rather than a scientific qualification; and yet when among the records of classical times we come upon traces of manners and customs which have survived for generations, and which seem to throw some rays of light upon the dim past, when history and writing were unknown, we are, I think, approaching the boundaries of scientific archeology.

Every reader of Virgil knows that the Greeks were not merely orators, but that with a pair of compasses they could describe the movements of the heavens and fix the rising of the stars; but when by modern astronomy we can determine the heliacal rising of some well-known star, with which the worship in some given ancient temple is known to have been connected, and can fix its position on the horizon at some particular spot, say three thousand years ago, and then find that the axis of the temple is directed exactly toward that spot, we have some trustworthy scientific evidence that the temple in question must have been erected at a date approximately 1,100 years B. C. If on or close to the same site we find that more than one temple was erected, each having a different orientation, these variations, following as they may fairly be presumed to do the changing position of the rising of the dominant star, will also afford a guide as to the chronological order of the different foundations. The researches of Mr. Penrose seem to show that in certain Greek temples, of which the date of foundation is known from history, the actual orientation corresponds with that theoretically deduced from astronomical data.

Sir J. Norman Lockyer has shown that what holds good for Greek temples applies to many of far earlier date in Egypt, though up to the present time hardly a sufficient number of accurate observations have been made to justify us in foreseeing all the instructive results that may be expected to arise from astronomy coming to the aid of archeology.

SIR JOHN EVANS.

The intimate connection of archeology with other sciences is in no case so evident as with respect to geology, for when considering subjects such as those I shall presently discuss, it is almost impossible to say where the one science ends and the other begins.

By the application of geological methods many archeological questions relating even to subjects on the borders of the historical period have been satisfactorily solved. A careful examination of the limits of the area over which its smaller coins are found has led to the position of many an ancient Greek city being accurately ascertained; while in England it has only been by treating the coins of the ancient Britons, belonging to a period before the Roman occupation, as if they were actual fossils, that the territories under the dominion of the various kings and princes who struck them have been approximately determined. In arranging the chronological sequence of these coins, the evolution of their types—a process almost as remarkable, and certainly as well defined, as any to be found in nature—has served as an efficient guide. I may venture to add that the results obtained from the study of the morphology of this series of coins were published ten years before the appearance of Darwin's great work on the "Origin of Species."

When we come to the consideration of the relics of the early iron and bronze ages, the aid of chemistry has of necessity to be invoked. By its means we are able to determine whether the iron of a tool or weapon is of meteoritic or volcanic origin, or has been reduced from iron ore, in which case considerable knowledge of metallurgy would be involved on the part of those who made it. With bronze antiquities the nature and extent of the alloys combined with the copper may throw light not only on their chronological position, but on the sources whence the copper, tin, and other metals of which they consist were originally derived. I am not aware of there being sufficient differences in the analyses of the native copper from different localities in the region in which we are assembled for Canadian archeologists to fix the sources from which the metal was obtained which was used in the manufacture of the ancient tools and weapons of copper that are occasionally discovered in this part of the globe.

Like chemistry, mineralogy and petrology may be called to the assistance of archeology in determining the nature and source of the rocks of which ancient stone implements are made; and, thanks to researches of the followers of those sciences, the old view that all such implements formed of jade and found in Europe must of necessity have been fashioned from material imported from Asia can no longer be maintained. In one respect the archeologist differs in opinion from the mineralogist—namely, as to the propriety of chipping off fragments from perfect and highly finished specimens for the purpose of submitting them to microscopic examination.

I have hitherto been speaking of the aid that other sciences can afford to archeology when dealing with questions that come almost, if not quite, within the fringe of history, and belong to times when the surface of our earth presented much the same configuration as regards the distribution of land and water, and hill and valley, as it does at present, and when, in all probability, the climate was much the same as it now is. When, however, we come to discuss that remote age in which we find the earliest traces that are at present known of man's appearance upon earth, the aid of geology and paleontology becomes absolutely imperative.

The changes in the surface configuration and in the extent of the land, especially in a country like Britain, as well as the modifications of the fauna and flora since those days, have been such that the archeologist pure and simple is incompetent to deal with them, and he must either himself undertake the study of these other sciences or call experts in them to his assistance. The evidence that man had already appeared upon the earth is afforded by stone implements wrought by his hands, and it falls strictly within the province of the archeologist to judge whether given specimens were so wrought or not; it rests with the geologist to determine their stratigraphical or chronological position, while the paleontologist can pronounce upon the age and character of the associated fauna and flora.

If left to himself, the archeologist seems too prone to build up theories founded upon form alone, irrespective of geological conditions. The geologist, unaccustomed to archeological details, may readily fail to see the difference between the results of the operations of nature and those of art, and may be liable to trace the effects of man's handiwork in the chipping, bruising, and wearing which in all ages result from natural forces; but the united labors of the two, checked by those of the paleontologist, cannot do otherwise than lead toward sound conclusions.

It will perhaps be expected of me that I should on the present occasion bring under review the state of our present knowledge with regard to the antiquity of man; and probably no fitter place could be found for the discussion of such a topic than the adopted home of my venerated friend, the late Sir Daniel Wilson, who first introduced the word "prehistoric" into the English language.

Some among us may be able to call to mind the excitement, not only among men of science but among the general public, when, in 1859, the discoveries of M. Boucher de Perthes and Dr. Rigollot in the gravels of the valley of the Somme, at Abbeville and Amiens, were confirmed by the investigations of the late Sir Joseph Prestwich, myself, and others, and the co-existence of man with the extinct animals of the quaternary fauna, such as the mammoth and woolly haired rhinoceros, was first virtually established. It was at the same time pointed out that these relics belonged to a far earlier date than the ordinary stone weapons found upon the surface, which usually showed signs of grinding or polishing, and that in fact there were two stone ages in Britain. To these the terms neolithic and paleolithic were subsequently applied by Sir John Lubbock.

The excitement was not less when, at the meeting of this association at Aberdeen in the autumn of that year, Sir Charles Lyell, in the presence of the Prince Consort, called attention to the discoveries in the valley of the Somme, the site of which he had himself visited, and to the vast lapse of time indicated by the position of the implements in drift deposits a hundred feet above the existing river.

The conclusions forced upon those who examined the facts on the spot did not receive immediate acceptance by all who were interested in geology and archeology, and fierce were the controversies on the subject that were carried on both in the newspapers and before various learned societies.

It is at the same time instructive and amusing to look back on the discussions of those days. While one class of objectors accounted for the configuration of the flint implements from the gravels by some unknown chemical agency, by the violent and continued gyratory action of water, by fracture resulting from pressure, by rapid cooling when hot or by rapid heating when cold, or even regarded them as aberrant forms of fossil fishes, there were others who, when compelled to acknowledge that the implements were the work of men's hands, attempted to impugn and set aside the evidence as to the circumstances under which they had been discovered. In doing this they adopted the view that the worked flints had either been introduced into the containing beds at a comparatively recent date, or if they actually formed constituent parts of the gravel, then that this was a mere modern alluvium resulting from floods at no very remote period.

In the course of a few years the main stream of scientific thought left this controversy behind, though a tendency to cut down the lapse of time necessary for all the changes that have taken place in the configuration of the surface of the earth and in the character of its occupants since the time of the paleolithic gravels still survives in the inmost recesses of the hearts of not a few observers.

(To be continued.)

PRESERVATION OF FRESH GRAPES AND SEED POTATOES IN ITALY.

CONSUL-GENERAL JONES writes from Rome, June 24, 1897:

A recent bulletin of the School of Agriculture of Scandicci, Italy, describes experiments made by Prof. Marchi for the keeping of grapes fresh during the winter. A certain quantity of grapes comprising different qualities was hung up in a cool and dry place, all damaged berries having been previously removed; a second lot was packed in dry, pulverized peat in wooden boxes. At the end of four months the grapes that had been hung up had become decayed and had dropped off; on the other hand, those that had been packed in the boxes were found to be in fine condition. This is, therefore, a simple and economical method. Another one consists in gathering the bunches with a good bit of stem attached and immersing their tips in bottles containing water and pulverized charcoal. Experiments were also made for preserving seed potatoes by using corn shucks, sawdust, peat, and very dry sand. The three first mentioned substances gave the best results, while the sand proved a failure.

ALPINIA NUTANS.

OUR illustration shows a plant of a genus not common in English gardens, but frequently met with on the Continent. The Alpinias (Globba) form a rather large genus of stove, herbaceous perennials of much beauty of flower and elegance of habit. The flowers are dis-

ALPINIA NUTANS.

Color of flowers, pink. Height to which a plant will grow, 12 feet.

posed in terminal spikes, those of A. nutans being pink colored, of agreeable fragrance, and the spike drooping. The leaves are lanceolate, smooth, entire, and sheathed at the base. The roots are fleshy, like most Zingiberaceæ, and have much the taste and aroma of ginger. Alpinias require a high temperature, rich soil, and plenty of root space. Therefore, they succeed better when planted in borders or large tubs, and frequent applications of liquid manure and rich mulches are essential to vigorous growth, and without this, flowering is poor or altogether repressed. Soon after flowering the leaves assume a yellow tinge, and water should be withheld, but much drying off must not be practiced. They must not be exposed to less heat when at rest than at other times. The flowers appear in May. We are indebted to the kindness of the Marquise Strozza, Florence, who sent us a photograph, for the opportunity of furnishing our readers with a figure of Alpinia nutans.—Gardeners' Chronicle.

The attention of the German and French governments has recently been directed, says the National Druggist, to a brand of cigarettes that has become a fashionable favorite under the name "Bouts dorés," or "Gilt ends." The end intended to go between the lips is covered with a metallic leaf which is claimed to be gold, but which analysis shows to be an imitation of gold attached to the paper by lead chromate. In another form, called "Bouts Argentés" (silvered ends), a false silver leaf is attached to the paper by white lead.

[Continued from SUPPLEMENT, No. 1130, page 18078.]

THE SCIENCE OF HUMANITY.

By W. J. McGEE.*

OF THE SCIENCE OF ANIMAL MAN.

THE domain of anthropology is vast, and, partly by reason of its very magnitude, is sometimes deemed indefinite; yet, in the light of the history of science in general, its limits and subdivisions may easily be outlined.

History and analogy combine to show that the study of man began with wounds and diseases and grew into surgery and medicine, which were at first thaumaturgic, but gradually became rational or scientific; and in this way definite knowledge of the human body gradually accumulated and anatomy and physiology, with various ancillary sciences and subsciences, took form and function. Meantime the organs of the human body were compared and identified with those of beasts and birds (which were long the better known), and comparative anatomy was established; but it was not until observation and generalization were fertilized by scientific zoology that the study of structures in their functional aspect took shape in morphology. Under the influence of humanitarian therapy and the unprecedented stimulus of the Darwinian doctrine of development, the investigations of the last century, and particularly the last quarter century, have extended from structures to functions, and these, through the fruitful science of embryology, to human ontogeny and phylogeny—to the individual and generic evolution of man considered as an animate organism. Accordingly, there are several branches of science which deal alike with the human organism and the various other animal and even vegetal organisms of the great vital series in which man is usually, though not invariably, considered the culminating and crowning form. Here anthropology and biology blend; but it is convenient and desirable to distinguish that division of the science of man which deals with the organic features of the order Bimana, and this science or subscience is frequently called somatology. Although the oldest and the simplest among the divisions of the anthropologic sciences, somatology comprises various special branches of knowledge commonly classed as sciences, including pathology, physiology, etiology, etc., representing the specific methods and purposes of particular classes of investigators.

The early books and maps of civilized nations show that explorers and pioneers were profoundly impressed by the faraway peoples encountered in their wanderings. There are not only accounts but pictures of headless men with faces in their chests, of Cyclops with single eyes set skyward, and of other impossible monstrosities in human semblance; even since zoology became fairly definite, accounts of ten-foot giants in Patagonia and three-foot pygmies in central Africa and other lands remote or hidden have gained currency and credence. As exploration continued, the unconscionable extravagances of vision were gradually corrected, and the explorers came to see alien races in proper form and something like proper stature; yet the interest in the stranger peoples remained unabated and led to systematic observation and record. Borrowing methods from biology, the observers or their interpreters sought to classify the men of different continents and provinces and islands by somatic characters—by stature, color of skin, color and texture of hair, color and attitude of eyes, form of feature, form and size of skull, peculiarities of long bones, etc.; and, as the researches became definite and fruitful, they were combined in a science of races called ethnology. This science has much in common with biology and is a direct outgrowth from the group of sciences pertaining to the human body combined under the term somatology.

After centuries of unscientific and unsuccessful search for the seat of the soul through baseless deduction and blind introspection, certain thinkers began to profit by contemporary researches in anatomy and physiology; and as eye and mind were trained—even as the eye and mind of the traveler were trained not to make monstrosities out of unfamiliar races—the form and function of the nervous system were gradually recognized, and the dominance of the brain was finally established. Only within a generation or two has the brain been investigated in a scientific way and with due appreciation of the importance of that marvelous ganglion preformed in the articulates, enriched throughout the long line of vertebrates, and perfected in the ultimate mammalian form of the genus Homo; yet during the present quarter century the research has been organized in a science already cultivated in many lands and taught in most of the leading universities. The earlier promoters of this science approached the subject haltingly from the speculative or deductive side, and perhaps for this reason the science is named not so much from the organ itself as from its product, psychology. This modern science is not to be confounded with the fantastic notions sometimes foisted under the same designation which do little more than obstruct progress; the parent stock of the science was indeed speculative—as is most knowledge in the beginning—but so soon as the graft of somatology was affixed it became fruitful. It is to be noted that while somatology is essentially biotic, and ethnology is biotic in so far as it rests on bodily features, psychology pushes beyond the domain of biology proper, partly in that the human brain owes its perfection of development to the essentially human attributes, partly in that the science, as commonly defined, embraces both brain and mind, both organ and product.

So there are three well-established and widely recognized sciences whose object-matter is man considered as an organism; by some students—especially those of past decades—they are held to constitute the whole of anthropology; by others they are combined as physical anthropology and regarded as including only the animal side of man, but excluding nearly the whole of the essentially human side—nearly, but not quite the whole, since the field of psychology is common ground. This is the view of several modern anthropologists, and is that held in this writing.

OF THE POTENCY OF DEVICES.

Passing from that portion of the domain of anthropology which deals with man as an animate genus, there is found another and still broader portion occupied by that which man does as a sentient, volitient and intelligent being. It is true that this portion of the domain is less definite than the other, yet, in the light of intellectual progress, its limits and subdivisions also may be outlined, albeit in some measure provisionally.

The early explorers who came home laden with travelers' tales sometimes brought also more tangible cargo in the form of strange wares; and so the handiwork of the world gradually came under the observation of students, and in time museums were built partly to accommodate the constantly increasing collections of primitive and alien arts. Meantime observant persons in many lands were attracted by relics of archaic culture in the form of implements, weapons, ornaments, apparel and habitations, as well as burial places sometimes containing the bones of the ancient artisans; and these, too, were collected and museums were built to accommodate them in connection with the artificial material gathered among the living peoples of distant lands. As collectors and collections multiplied, the work was organized; and, although the initial stimulus came from observation in remote countries, the interest grew inward—as is the way of advancing knowledge—and the local research for the rare relics of past ages was the first to receive name and character as the science of archæology. As observations multiplied, resemblances were found between the culture products of remote times and remote places. The arts of primitive peoples were found to vary in a manner corresponding more or less closely to race, and thereby ethnic research gained new impetus and served in turn to guide research in the prehistoric; so archæology and ethnology became mutually helpful and grew apace and came to be intimately associated in most minds, despite the fact that the one is concerned primarily with what man is, the other with what man does; and in some circles these branches of inquiry came to be regarded as constituting the whole of anthropology.

At first the products of ancient and alien handiwork were accepted at their token value, much like the chemic elements before Avogadro, the planetary movements before Newton, our sun and others before the doctrine of the persistence of motion, the organic species before Darwin; but within a generation or two it has come to be realized that they possess an innate value as exponents of intellectual activity—as medals of human creation collectively attesting the birth and growth of discovery and invention, design and motive, and all other human faculties. Perhaps the time has not come for defining this stage in the progress of anthropology; it may be that the transition is not yet complete, or that the relations are too complex for easy grasp; yet it seems clear that when the anthropologist first saw in the implement of shell or stone an index to the mental operations of the implement maker hardly less definite than the written page to the thought of the writer, the science of man rose to a higher plane with a bound comparable to those marking great epochs in the development of the other sciences.

* Vice-presidential address before Section H of the American Association for the Advancement of Science, delivered at Detroit, August 9, 1897.

Now in science each advance gives a new standpoint from which a broader view may be gained; and with the recognition of what may be called the dynamic aspect of artificial objects, the way was prepared for further progress. It was soon perceived that the simplest devices are supplements to or substitutes for bodily organs—that the knife of shell or tooth or stone is a supplement to teeth and nails, that the hammer stone multiplies the efficiency of blows, and that the missile is equivalent to an indefinite prolongation of reach; and accordingly it was realized that, in so far as he is a maker and user of implements and weapons, even the lowest savage rises above the plane of purely animal life. It was next perceived that even the simplest devices react on the organisms in various ways. The substitution of the shell knife for nails and teeth diminishes the exercise, and hence the vigor of these organs, and removes them from the category of characters subject to development through the survival of the fittest in the strife for existence, so that in so far as he employs devices in lieu of organs the savage passes beyond the realm of organic development by natural selection; at the same time the exercise of making and using artificial devices in lieu of natural organs tends to develop distinctively intellectual or cerebral characters; so that the effect of competition in the use of devices is not only to remove man from the realm of the biotic, but to set him on a definite course of development in a new realm—the realm of the artificial or essentially human. As the view of the artificial continued to broaden, it was perceived that while the simpler devices may appertain to individuals, they are not an integral part of the individual like the organs which they supplement, but may and do pass from hand to hand and from group to group; also that the use of a device by one person prompts others to acquire and use similar devices, which they are able to do through mere exercise of volition, so that each discovery or invention is at once the germ of a line of devices and a stimulus to intellectual power; and thus it was recognized that there is a strong communal tendency in the realm of the artificial, that the tendency of the development of devices is toward interchange and co-operation, yet ever of such sort as to augment intellectual power and elevate the human above the subhuman.

In the light of the dynamic interpretation of devices it is easy to perceive the trend of superorganic succession, or development of the artificial, and to contrast it with the course of biotic evolution; the substance or substratum of the latter is living matter, that of the former any matter, living or dead, with which man chooses to deal. The mode of this is slow elimination of the unfit and unpremeditated survival of the fit, the method of that is immediate imitation and designed improvement of the ingenious; the tendency of biotic evolution is toward organic differentiation, that of artificial development mainly toward organic persistence, with endless multiplication and integration of devices. The effect of the one is individual or egoistic, that of the other communal and altruistic. With the recognition of the dynamic and successional aspects of artificial devices, anthropology gained a new significance; for to its objects-matter in the form of the human body and human races and the human brain there was added the whole series of artificial devices and the exceeding potent intellectual activities which these devices represent, and this addition is the basis of what is here styled the Science of Humanity.*

OF THE ACTIVITIES OF MAN.

When artificial devices were interpreted in terms of activities, a new classification of human handiwork arose. At the same time the activities themselves became objects of research, which soon passed beyond the collections, and extended to the multifarious material devices in daily use among living peoples in the various stages of civilization from savagery to enlightenment; still later the research was extended to the intellectual or non-material devices which pre-eminently distinguish mankind, such as law, letters, and learning, in their numberless aspects. The study of the activities is now sufficiently advanced to indicate, at least provisionally, their relations among each other and to the merely organic processes; they may be arranged in the inverse order of their affinity with the vital.

1. The primary activities of mankind are connected with more or less spontaneous sensations of pleasurable character. They arise and expand in fairly definite order; among known primitive peoples they appeal chiefly to the senses, and among more advanced peoples they appeal largely to the emotions and the purely intellectual faculties; they root in sports, games, and decorations, and mature in the fine arts of painting, sculpture, the drama, poesy, and music, i. e., they constitute the esthetics. The artificial devices growing out of these activities go far toward filling those museums of the world devoted to archaic and ethnic material; and nearly a third part of current anthropologic literature is devoted to this class of objects and the activities which they represent. These activities and activital products form the object-matter of a broad and fruitful field of inquiry known of late as esthetology.

2. Intimately connected with the primary activities, and also originating in spontaneous vital processes, though becoming dominant only by organization through exercise and volition, there are other activities tending toward the maintenance of physical welfare. From a simple beginning in occupations akin to those of the beasts, they arise and expand with each step in cultural advancement from savagery to enlightenment; at first confined to food getting, they extend also to the making of apparel, the building of habitations, and eventually to the supply of intellectual demands, i. e., they constitute the industries of common parlance. The material devices growing out of the industrial activities have enriched anthropologic museums almost equally with those growing out of esthetic activities; and probably a fourth part of the current literature of anthropology is devoted to them and the activities by which they are produced. Together they form the object-matter of a broad and rich science commonly called technology.

It is to be noted that the greater part of the material investigated by the archeologist pertains also to the fields of esthetology and technology, though these are far broader in that they extend not only to a greater variety of activital products, but to the activities themselves. It may also be noted that both esthetics and industries, originating as they do in vital processes, are primarily individual, though they become collective partly through combination with higher activities; while the higher activities of the series are primarily collective. It is noteworthy, too, that the two lower classes of essentially human activities rest on a material basis and are represented primarily by material devices, while the activities of higher planes rise above the material in their essential character and are only incidentally represented by material devices.

3. The activities of the third class are connected with collective relations; and since they grow out of consanguinity or family relation they may be said to have a biotic germ. In general, the products of these activities originate as customs which grade into regulations and later into laws, and are perpetuated in tribal, national, and other institutions. The activities and their products are most intimately connected with and indeed form the chief basis of cultural progress. In the first culture stage, corresponding to what is commonly called savagery, the collective or social relation is based on kinship traced in the maternal line; in the stage commonly called barbarism, social relation rests on kinship traced through the paternal line—these stages forming tribal society. In the third stage the social organization passes from patriarchy through feudalism or an equivalent intermediate condition not yet formulated to that stage of individual property right in lands and goods which is commonly called civilization; and men are now passing into the stage characterized by intellectual property right which is commonly called enlightenment—the organization in the last two stages being essentially nonconsanguineal and constituting what is sometimes called national society. The several activities and activital products belonging to this class form the object-matter of a fecund science commonly called sociology—though the day of final agreement concerning the definition of the term is not yet.

4. In some measure the activities of the fourth class are an outgrowth of those of the third, since they are essentially superorganic and may be regarded as a means of establishing and maintaining relation; they comprise expression, pantomimic, oral, and graphic. Like the other activities, they arise and expand in a certain order; beginning with what is somewhat incongruously called gesture speech and with rudely articulate language, they mature in oratory and literature; and it is significant that the lines of development, so far as ascertained, run counter to those of biotic evolution, in that they are almost wholly convergent instead of divergent—so that these activities pertain, in every essential respect, to the superorganic realm of humanity. The principal activities are speech and writing; the tangible products are legend and literature—but the rich and ever growing content of these products is knowledge. The activities of expression and their products are commonly combined as the object-matter of another science frequently called philology—though in this case, too, there is diversity in definition and also in designation.

5. There remains a class of elusive and Protean yet immeasurably potent activities which come so near the Ego and are so hard to grasp and difficult to convey that it would seem almost hopeless to attempt to define them; they are the essentially intellectual activities which form the motive and burden of expression, and their products comprise beliefs, opinions, knowledge, wisdom, and all other purely intellectual possessions. These activities also arise in a definite order which is set forth summarily in earlier paragraphs; and by the most systematic thinkers they are considered to mature in science. The activities and their products are so obscure and so diverse that they have not been combined and named in the vernacular; yet they are by some students regarded as the object matter of one of the broadest of the special sciences, sophiology.*

So there are five classes of essentially human activities and activital products, each so rich in phenomena and principles and so far distinct from all other classes of things as to constitute an adequate basis for a science; they are the fine arts or esthetics, giving basis for esthetology; industries, forming the object-matter of technology; organizations or institutions, affording foundation for sociology; language and literature, with their science of philology; and the great plasma of knowledge, forming the ill-defined but all-important object-matter of sophiology. The five fields of research pertain primarily to man, and thus represent anthropology; yet even casual survey of their extent and character renders it evident that they pertain not at all to the animal side of man, but wholly to that side which intellectual man alone possesses—they are five sciences of humanity. Partly to distinguish them from the three distinct branches of knowledge concerning animal man, partly to fix their place in the body of knowledge, they have recently been combined under the term demonomy;† and this system of organized knowledge concerning wholly human things may fitly be designated the science of humanity.

As knowledge arises, it is applied to the promotion of happiness and welfare; this has been true of unorganized and unconsciously organized knowledge throughout the history of mankind, and is especially true of definitely organized knowledge, which thereby becomes applied science. Now knowledge concerning the human activities, even while unconscious or half conscious only, reacts upon and shapes the activities in such manner as constantly to increase their potency. Some of the ways in which the science of humanity stimulates and strengthens human activities are especially noteworthy.

1. While the great domain of anthropology is divisible into an animal side comprising three broad sciences and a human side made up of five still broader fields of research, other classifications are possible, and indeed of special utility when directed toward the practical application of the science to everyday affairs—for any assemblage of facts and relations may be classified in as many ways as there are purposes of classification. Experience shows that there is a peculiar advantage in classifying certain sciences by method of research rather than by the objects under investigation. Classified in this way, anthropology comprises (1) demography, i. e., the enumeration and description of men, activital products, etc.; (2) human geography (or anthropogeography), dealing with the geographic distribution of peoples and their products; (3) political economy, which is concerned primarily with applied social forces and their products; (4) history, which deals with the rise and fall of peoples and nations; and (5) philosophy, which scrutinizes materials and forces and sequences and seeks the causes of growth and decadence among human things. This classification traverses the same domain as the more general one, and serves to bring out the same facts and relations in somewhat different light, i. e., it is artificial rather than natural, technical rather than logical, subjective rather than objective, directive rather than creative; in brief, it expresses applied science rather than original research. For certain purposes it is desirable to combine the classifications and define special fields of inquiry by the coincidence between the two, as has recently been done happily by Giddings* and others; for the lines of thought represented in the two systems are strengthened by interaction—the one may be said to represent science and the other statecraft, and the two combine to advance mankind in knowledge and power.

2. At the outset the science of ethnology was closely affiliated with zoology, representing indeed little more than the concentration of biologic inquiry on a single order of animate organisms; but with the recognition of human activities, this science was raised to a new plane. The applications of demonomy in the classification of peoples and races are many and sweeping; already the natives of the western hemispheres are classified primarily by language and incidentally by other demotic features rather than by any or all biotic characters; already the great stages in human progress from savagery to enlightenment are seriated in terms of social organization in lieu of those of the bodily features with which the biologist is wont to deal; already the present day ethnologist gives first thought to the arts, industries, institutions, languages, and ideas of the races rather than to any or all of those individual features comprised in stature and form and color; already, indeed, the recognition of human activities and the course of human development has served to revolutionize the science of races no less completely than the older sciences were revolutionized by recognition of force and sequence; and just as the new chemistry, the new astronomy, and the new geology are distinguished, so it is meet to distinguish a new ethnology as a science of artificially organized groups rather than a science of mere upright animals.

3. With the rise of knowledge concerning activities, it was perceived that the primary function and eventual design of devices have always been to extend and increase human power, to enable man to control plants, subjugate animals, and to evade or utilize sun and storm, i. e., to make conquest of lower nature; accordingly it was recognized that, while the human characters reflect environment measurably, as the purely biotic characters do fully, it is the essential tendency and function of man to control, rather than to be controlled by, his environment. This human power did not spring into being full-fledged—indeed modern science knows no Minervan birth—but grew up slowly through the exercise and gradual strengthening of volition and the evolution of design; so primitive peoples are measurably controlled by their environment, while the control diminishes with successive culture stages up to that of enlightened man, who dominates by multifarious devices nearly every physical force. Examination of the successive stages in emancipation from environment brings to light many significant relations; thus it is found that when two or more primitive peoples of similar culture are subjected to similar conditions of environment their minds respond in similar ways, so that similar devices are discovered or invented; and recognition of this law of human progress has served to correct some of the most persistent misapprehensions by which anthropology, like all other sciences in their infancy, has been burdened. At the same time the recognition of progressively increasing conquest over the inorganic and the organic merely has served to define and dignify man's estate at the head of all nature.

4. Although certain human characters and characteristics were already under investigation, it can hardly be said that mankind in general came into the domain of scientific inquiry until the Darwinian doctrine of evolution was accepted; accordingly, anthropologists at first regarded man as subject to the law of organic development through the survival of the fittest. Then came the recognition of activital development in contradistinction from organic development; and the pendulum of opinion swung back so far that most modern anthropologists implicitly assumed the human generic form to be fixed and final, so far as organic development is concerned. It now appears that the pendulum swung too far; for a long series of highly significant yet but half appreciated observations indicate that, just as the human mind dominates the materials and forces of lower nature, so may it measurably control and fashion the organism in which it is embodied—already hygiene and gymnastics have improved unnumbered physiques and lengthened the days of thousands; already leading educational institutions maintain physical departments in which they undertake so to shape and strengthen the limbs and lungs and even the heart and bone of the matriculate that he may be graduated sound in body as strong in mind; yet these indications would seem only to point the way of progress and promise still better things in human development as later generations rise.

* The enlargement of the domain of anthropology as here set forth is regarded as marking the most important epoch in the development of this science, one of the most important in the history of science in general. Several investigators have contributed to it; perhaps the earliest, one of the most voluminous, and certainly the most original of these contributors is J. W. Powell, whose preliminary writings have appeared in a large number of addresses, official reports and minor papers, though his final results are not yet published.

* Sixteenth Annual Report of the Bureau of American Ethnology, 1897, page xviii.

† Fifteenth Annual Report of the Bureau of Ethnology, 1897, page xix.

* "The Principles of Sociology," '96, page 49.

Acid-proof Cement.—A coating which may be used to protect vessels from the action of the strongest acids is prepared by thoroughly mixing 2 p. of powdered asbestos, 1 p. of barium sulphate and 2 p. of soluble glass solution of 50° Be. gravity. For the feebler acids a glass solution of 30° Be. may be used.—Pharmaceutical Era.

ELECTRICAL NOTES.

The sea going car on the Brighton and Rottingdean Electric Railway has resumed work.

The installation of a system of electric car lines at Vienna is being considered, and it is hoped that the service will commence on May 1, 1898.—Electrotechnische Rundschau.

A blast was fired by lightning at Rockland, Me., on June 28, killing one man and badly injuring two. Eight loaded holes were being connected for firing, when lightning struck the battery wire, thus prematurely firing the charges.

A fifth telephone connection is to be laid between Stuttgart and Goeppingen, Germany, as the four used hitherto are becoming insufficient for the growing service. The line is also to be extended to Geislingen.—Electrotechnische Rundschau.

Recently Marconi's experiments in telegraphy without wires were renewed at the Ministry of Marine, at Rome, before a number of journalists. Signor Marconi was to exhibit his apparatus before the King and Queen of Italy, and afterward proceeded to Spezia to transmit messages between different ships intercepted by other vessels.

The latest novelty in the way of buoys is an electric lamp supported by a buoy of 100 lb. weight, sufficient to bear up three men. It is provided with a secondary battery which preserves its charge for two months, and can supply current for lighting the 16 candle power lamp for six hours. The light is projected through a lens, and is visible a mile off.—Revue Industrielle.

The new Berlin Omnibus Company, says the Elektrotechnische Zeitschrift, intends to run a trial accumulator vehicle, and the order for its manufacture has already been placed. It is to be of the same size as an ordinary omnibus, with seats on the roof, and the cells will be placed both under the inside and outside seats. The cells will be charged after every two journeys (the length of the journeys is not mentioned). The company anticipates a considerable saving by the use of electrically propelled cars, as 10 horses daily are now required for an omnibus.

An electrical exhibition was opened in Riva, in the Tyrol, on May 27 last. Its main object is to draw the attention of industrial and agricultural circles in southern Tyrol to the manifold applications of electric power. Very little use is made of the waste water power in this district, though it is very abundant. The small market towns of Pergine and Roncegno have electric light, and also the health resort Arco, and Riva started a large water-driven generating station last year, but that is all. The most interesting feature of the exhibition, says the Wiener Zeitung, is the collection of light electrically-driven machines and labor-saving appliances shown by the Technological Trade Museum. A large number of the machines exhibited are shown in action.—The Electrician.

At Capetown considerable trouble was lately caused by an electric tramway line which had been laid in proximity to the submarine cable of the Eastern and South African Telegraph Company. This cable is looped around Table Bay in order to be out of the way of any anchors, and is connected to the wire on land at Adderley Road. For some 2,000 yards the trams run at a distance of about 900 yards from the cable. It was noticed as soon as the tramway was run that whenever a car started, a kick was given by the receiver. When sand or any other obstruction came between the wheels and the rails, the lines traced by the telegraph were uneven. All attempts to get rid of these troubles proved vain until a secondary cable was laid alongside the original one, for ten miles, connected on the land end to the receiver and on the further end to earth.—L'Electricien.

Owing to the intensity of the electric light used on board of men-of-war, men are frequently affected with eye complaints, which in some cases have led to total blindness. It is said that eyes in which the iris is not heavily charged with pigments—that is to say, gray and blue eyes—are more likely to be injuriously affected than brown eyes. These eye troubles are ascribed to two causes—viz., the intensity of the light and the action of the ultra-violet rays. Oculists recommend the interposition between the eye and any powerful light of a transparent substance which will intercept the ultra-violet rays, such as, for instance, uranium glass, which is yellow. The French naval authorities supply dark blue glasses for the use of those men who have to do with search lights, etc., and the cases in which injury has been caused to the eyes were those of men who had neglected to use these spectacles, which, however, do not appear to afford any protection against the ultra-violet rays.—Revue du Cercle Militaire.

The question of a proper or desirable unit for rating the efficiency of an electric plant is still open, says Power. If the pounds of coal per kilowatt hour be taken, the question immediately arises, "What kind of coal?" This objection cannot be met by substituting the calorific value of the coal and making the unit of comparison thermal units in coal per kilowatt hour, for a thousand heat units in one kind of coal are more available than in another, so that the question, "What kind of coal?" still stands. The money cost per kilowatt hour is not a correct basis for comparison of efficiencies, except among stations which are similarly situated with regard to cost of fuel. Professor William S. Aldrich proposes the kilowatts per million thermal units in the steam supplied to the whole station on a basis similar to that in vogue for pumping plants. This is an admirable system for specifying the efficiency of a pumping engine, and would be equally good for a steam dynamo, but, aside from the difficulty of determining accurately the heat units supplied to a station which will always define the heat unit as a scientific rather than a popular method, there is the fact that such a rating leaves out of account altogether one of the principal features of the station—the steam generating plant. Probably the most satisfactory popular expression of the efficiency of a station is the pound of coal per kilowatt hour, with a statement as to the class of coal used. In reporting a test, of course, all the data should be given, so that the reader may select that unit in which he is accustomed to think, and so that the reason for the result may be apparent.

MISCELLANEOUS NOTES.

The use of paper for floorings has many advantages over that of wood. Paper, being a bad conductor of sound and heat, insures on the one hand privacy, and on the other a comfortable temperature in both summer and winter. To the foot a paper floor, though harder and more durable than wood, gives a similar impression to that produced by linoleum, and, being made in one piece, has no cracks to shelter all kinds of vermin.—Monatschrift für den Baudienst.

Rubber mats are now made for use in the bottom of porcelain bath tubs, the glassy surface of which is liable to cause painful accidents from slipping. The India Rubber World says that many a case of broken rib or serious bruise has been caused by a bather falling against the iron rim or sides of highly finished tubs. Cork mats have also been used, but are less desirable than rubber, as they chip off from frequent soaking, and pieces are apt to clog the pipes.

Very good porous bricks are made by the director of a mine in Libuschin, near Kladno, Bohemia, from a mixture of clay and bituminous slate. This latter is obtained in great quantities in the process of washing coal. The bricks made from this material are cheap, very strong and only about one-half as heavy as the ordinary stones. They are, moreover, bad conductors of sound and heat. At Vienna the price paid for them is $6.25 per thousand.—Monatschrift für den Oeffentlichen Baudienst.

Dr. Schott, of the Jena laboratory, has made a discovery by which he is enabled to raise the luminosity of the incandescent gas light by some 60 per cent. He noticed a considerable increase in the light given by a burner if the air struck the mantle at right angles instead of, as usual, almost parallel. He has devised a burner in which the air is fed into the flame so as to stream from the center against the mantle, the glass chimney being widened and the usual circular opening at the bottom closed.—Prometheus.

A new use of aluminum has been discovered in the manufacture of reproducers for talking machines. The reproducer is the apparatus which holds the vibrating diaphragm of glass. Heretofore the recorders and reproducers of talking machines have been made, as a rule, of hard rubber. For hard rubber, aluminum has been substituted, with what is regarded as much success. It is claimed that the blasting, blaring, or "chattering" as it is called in the trade, which is often noticeable in the performance of the talking machine, is almost completely absent when an aluminum reproducer is used.

A patent has recently been taken by the Society of Chemical Works at Mannheim, Germany, for a new process for the preparation of potassium or sodium thio-sulphate. The chloride of the metal is first treated in the usual way, a bicarbonate being obtained, then this product is acted on with sulphur dioxide in the presence of sulphur, water and sal ammoniac; the escaping carbon dioxide and the ammonia, taken up from the ammonium chloride, once more serve to prepare the carbonate from the chloride, so that the same material is used over and over again. The process is carried out in a series of retorts, some of which serve for the production of the bicarbonate, while in the others this is transformed into thio-sulphate.—Die Chemische Industrie.

Messrs. Siemens & Halske, of Berlin, have invented a process for purifying starch, which is based on the oxidation of the cellulose into oxycellulose by oxidizing agents and nascent chlorine, the latter being prepared by the action of hydrochloric acid on potassium permanganate. The starch is dissolved in cold water, then the manganate is brought to act on it, and this process is continued until the salt is no longer discolored. After this the starch must be bleached, for the manganese peroxide produced in the reaction has given the substance a brown color. This bleaching is readily effected by the addition of sulphurous acid, which removes the peroxide. The oxidation of the cellulose is effected by shaking the brown starch in a bath of dilute hydrochloric acid. When the product is totally soluble in an alkaline solution, it is ready for bleaching.—Revue Scientifique.

The Department of State publishes the following from Consul Monaghan, dated Chemnitz, May 17, 1897: Berlin and Leipsic are boasting about a new invention, to be known as iron felt. It is made of the very best woolen materials, impregnated with the inventor's patented preparation, which gives it 2,220 pounds' power of resistance to every square centimeter (0·3937 inch). The article is most useful for railroads of all kinds. Placed between rails and sleepers, it deadens sound and prevents shocks. The first experiments with the new material were made by the Berlin City Street Railway, over which 300 trains pass daily. The results surpassed the company's most sanguine expectation. Not only was the noise brought down to a minimum, but the wear and tear was materially diminished. It is to be tried on the new roads in Leipsic. Old buildings, and particularly buildings of stone and iron, suffer most from the shocks and noise of passing trains. Such an insulating material seems to be especially adapted for elevated roads.

The Philadelphia Fire Underwriters' Association has decided to grant permission for the use of acetylene gas in liquefied form under pressure for lighting purposes, provided that the pressure of gas on the piping in the building to be assured shall at no time exceed one-quarter pound per square inch, and that the cylinder containing the liquefied gas under pressure and all pressure-reducing and safety devices be located outside of such building, and in a separate building well ventilated to the outer air, but of sufficient strength to protect the apparatus from outside interference and from the weather (especially the sun's rays); and that the supply pipe for the building be provided with a hand valve just inside of the building assured, so that the gas may be entirely shut off from such building. It is also provided that the cylinder containing the liquefied gas under pressure shall be equipped with a safety valve to protect against both excessive pressure and unusual increase of temperature, and that both the pressure-reducing and the safety (mercury) valves shall be provided with vent pipes opening into the outer air; and that no acetylene gas or calcium carbide shall be stored on the premises.—Jour. Franklin Institute.

SELECTED FORMULÆ.

For Sunburn, etc.—

ALKALINE LOTION.

Bicarbonate of soda	2	drachms.
Powdered borax	1	"
Compound tincture of lavender	1½	"
Glycerin	1	ounce.
Rosewater	4	"

Dissolve the soda and borax in the glycerin and rosewater, and add the tincture. Apply with a small piece of sponge two or three times a day. Then gently dry by dabbing with a soft towel.

QUINCE CREAM.

Quince seeds	2	drachms.
Distilled water	10	ounces.
Glycerin	2	"
Alcohol, 94 per cent	1	"
Rosewater	2	"

Boil the seeds in the water for ten minutes, then strain off the liquid, and when cold add to it the glycerin, alcohol, and rosewater.

GLYCERIN CREAM.

White soft soap	2½	drachms.
Glycerin	1½	"
Almond oil	11	"

Well mix the glycerin and soap in a mortar, and very gradually add the oil, stirring constantly until perfectly mixed.

BISMUTH LOTION.

Subnitrate of bismuth	1½	drachms.
Powdered French chalk	30	grains.
Glycerin	2	drachms.
Rosewater	1½	ounces.

Mix the powders, and rub down carefully with the glycerin; then add the rosewater. Shake the bottle before use.

ALMOND CREAM.

Glycerin cream	2	drachms.
Jordan almonds	4	"
Rosewater	5	ounces.
Essential oil of almonds	3	drops.

Blanch the almonds, and then dry and beat them up into a perfectly smooth paste; then mix in the glycerin cream and essential oil. Gradually add the rosewater, stirring well after each addition; then strain through muslin.—Bulletin of Pharmacy.

French Blacking (Jacquard's).—

	Parts by weight.
Freshly calcined animal charcoal	750
Muriatic acid	250
Treacle	1,000
Prussian blue	30
Indian lake	30
Olive oil	500
Total	2,500

Treat the charcoal with the acid, stir in the finely ground Prussian blue and Indian lake, then the olive oil, and finally the treacle. The olive oil may be replaced by a cheaper one. The blacking made from spent charcoal from sugar refineries goes mouldy.—Oils, Colors and Drysalteries.

Nail Cosmetics.—A "nail wash" sometimes used is:

Oxalic acid	30	grains.
Rosewater	1	ounce.

As a varnish or polish use:

Paraffin wax	60	grains.
Chloroform	2	ounces.
Oil rose	3	drops.

—Pharmaceutical Era.

Varnish for Violins, etc.—

Mastic in tears	10	parts.
Dammar, soft white	5	"
Colored turps	100	"
Raw linseed oil	5	"

It is made as follows: A layer of ground glass is placed in a wide bottomed flask, then the 100 parts of the colored turps, then the mastic, and the two left in contact together for several hours, with frequent shaking. The dammar is then added, which takes another twenty-four hours for solution. In winter each period will require to be extended to thirty hours. The oil is then added, and well incorporated with the varnish by frequent shaking. After standing for another fifteen hours in diffused daylight, the whole is filtered through a cotton cloth. The varnish is greatly improved by keeping from six to eight months before use. The red coloring matters are sandalwood deep (Caliatour), dragon's blood, and gamboge for the yellow, mixtures of the three giving any desired tint.—Oils, Colors and Drysalteries.

Swiss Alpine Milk Shake.—

Mint sirup	5	pints.
Fine Rhine wine	2	"
Messina lemon sirup	½	"
French rose cordial	½	"

Mix well together and filter.

For dispensing, put 1½ ounces of this sirup into a tumbler, clean cracked ice half glass, fresh milk enough to fill glass; then shake thoroughly and top off with a piece of mint.

Stove Polish.—The following formula has been used with very satisfactory results by some of our readers: Melt 400 grammes of asphalt on the open fire, allow to cool, break up and dissolve in sufficient oil of turpentine to bring the whole up to 1,000 grammes.

Moth Paper.—

I.

Carbolic acid	1	ounce.
Ceresin	1	"
Naphthalin	2	"

Melt, immerse pieces of bibulous paper, and dry these on plates.

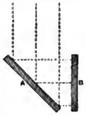
II.

Carbolic acid	1	ounce.
Camphor	1	"
Benzin	to make 1 pint.	

Saturate pieces of blotting paper, and apply, or use the liquid in the form of spray by means of an atomizer.—American Druggist.

ULTIMATE OPTICAL EFFICIENCY.

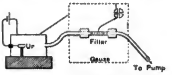
SOME years ago Rayleigh discussed the relative limiting accuracy of the two methods then commonly in use for observing small angular deflections of a suspended system, i. e., the Gaussian method of scale and mirror and the method of the pointer and microscope. The conclusion was reached that theoretically the two systems were on a par with each other when the length of the pointer was equal to the diameter of the mirror. This would give an advantage to the pointer, since that may easily be made ten times as long as the mirror, but in practice this advantage is not maintained. A third method is that based on the interferometer principle, as suggested by Barus and Wadsworth. The latter is of opinion that the smallest movement that can be measured with certainty by this means is that corresponding to a shift of one-twentieth of a fringe. This reduces the estimate of Michelson, who showed that, theoretically, this method of angular measurement may be made from twenty to fifty times as accu-



rate as either of the others referred to. What interferes with the efficiency of the new method is the unsteadiness of the mirrors whose motion lengthens and shortens the path of the interfering beam. Besides, the necessity of two mirrors increases the moment of inertia of the suspended system, and in some cases actually gives the older methods the advantage. Of the two latter, the German method of scale and telescope has the advantage over the English "spot" method, chiefly because of the greater fineness of the reference line (a cross wire in the telescope). A simple way of doubling the efficiency of either method is illustrated in the diagram. The beam is reflected by the movable mirror, A, on to a stationary mirror, B, placed close to it. The latter reflects the beam nearly in the same path, but any angular motion of the mirror, A, produces a motion of four times the amplitude after three reflections. In order to realize the full effect of the aperture of the mirror the two mirrors should be more nearly parallel than shown, and should be as close together as possible.—Wadsworth, Phil. Mag., July, p. 83.

ELECTRIFICATION BY URANIUM.

J. C. BEATTIE has investigated the electrification of air by metallic uranium and its compounds by means of the electric filter method. The filter used was a block tin tube ten centimeters long and one centimeter wide, filled with brass filings. This was insulated on two tunneled pieces of paraffin, and put in metallic connection with the insulated pair of quadrants of a quadrant electrometer of one ten-thousandth microfarad capacity. From one of the pieces of paraffin a metal tube led to an air pump, from the other a piece of India rubber tubing led to the place where the air to be tested was. This air was then drawn through the electric filter, and the deviation of the electrometer reading was noted. The latter showed 0·7 volt as the electrification of the filter by air drawn from the neighborhood of the positive electrode of a Ruhmkorff coil when the terminals were too far apart to allow a spark to pass after one minute of pumping. To examine the electric state of the air in the neighborhood of metallic uranium charged to a given potential, the following experimental arrangement was made: A me-



tallic cylinder was closed at both ends, which were perforated. Air was admitted through one opening, which was plugged with cotton wool, while the other led to the filter. In the cylinder the piece of uranium was placed on a stick of paraffin. No electrification of the air was produced by substituting a piece of lead and charging it up to 95 volts. When the uranium and the copper cylinder were both connected with the sheaths of the electrometer, a deviation of 0·05 volt per minute of pumping was produced. When the uranium was joined to one terminal of a battery, while the cylinder was joined to the other terminal and to the sheath, the electrometer deviation was from + 0·36 to −0·40 volt per minute, when the charge of the uranium was varied between + 93 and −95 volts. Experiments with zinc, aluminum and lead cylinders showed that the nature of the metal did not influence the result. Wrapping the uranium in aluminum foil diminished the electrification, and surrounding it with paraffin wrapped in aluminum stopped it altogether. Similar, though much smaller, electrifications were obtained with uranium acetate and nitrate.—Beattie, Phil. Mag., July, p. 102.

A peculiar method for making castings which are to be partly of hard and partly of soft steel is described in Stahl und Eisen. If a carriage wheel is to be cast with a hard rim, the form is rotated and hard steel poured in. The centrifugal force sends it round the outer edge, so that it forms a rim, and when it is somewhat cooled, the soft steel is added. By this process a very intimate union is obtained, and the wheel is provided with a hard steel rim. The transition from one grade of steel to the other is not gradual, but is sudden.

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THE KLONDIKE GOLD FIELDS.

By H. K. CARROLL, LL.D.

KLONDIKE is a word found neither in dictionary nor gazetteer, and you will look in vain for it in the latest wait for it. They are already on their way to the new country to "stake out" claims, thaw the frozen gravel, dig masses of earth, and "pan out" the "dust." The trail, we are told, is strewn with the bodies of the victims of the craze; and many of the miners who un- The greed of the Spaniards of Pizarro's day for the shining metal was no greater than that which was manifested in the wild rush for California and Australia nearly half a century ago. The news of gold discovery seems to have the power of creating a fever in the

DEPARTURE OF THE "EXCELSIOR," BOUND FOR ST. MICHAELS, CARRYING GOLD SEEKERS.

atlases. A few weeks ago nobody except a few whites and Indians had ever heard of it; now who is there who has not had it on his tongue many times? It has quickly become a magical name, and at its mention golden visions enchant the imagination, and big yellow nuggets and bags of shining dust seem actually to strain the muscles of the hand. The map makers must be diligent and give the world a chart of the new Eldorado. The greedy gold hunters will not, however, covered sudden riches are themselves covered by the soil in which they found the wealth they were never to enjoy.

But crowds will go after gold, anywhere, everywhere, at any cost of suffering and deprivation. They will dig and starve, and even die, amid equatorial heats or polar snows for a handful of yellow earth.

"Gold many handed, sweat and bled for gold,
Waked all the night and labored all the day."

blood, and men, and, in these latter days, women as well, hurry off at mad speed to have their chance, often a very slim one, at fortune.

Where is Klondike? The map given herewith, made from the latest chart prepared by our government, shows that it is in the Queen's dominions, close to the border of our Alaskan possessions. It is in the Northwest Territory, and is, of course, under Canadian control.

It will be observed that it is quite close to the Arctic Circle, whence it may be inferred that its winters, if not its summers, are apt to be rigorous. The summers, beginning in May, are about four months long, and the sun, notwithstanding the high latitude, warms up the atmosphere so thoroughly that sometimes the thermometer climbs above ninety. But surely the nights must be cool, for the gravel, we are told, is frozen down to bed-rock, twenty or twenty-five feet. They might be, if there were any; but for months the people of that region never lose sight of the sun, and at midnight, if it is proper to use such a term, it is almost as light as at noonday.

The country is not entirely barren. Parts of it grow a species of pine which attains a size suitable for boards

and building purposes, and there is a small sawmill at Dawson City to turn out materials for houses. We are also told that miners have had some success in planting gardens. There is little or no game, however, and there does not seem to be an abundant supply of fish in the numerous streams. The Klondike, they tell us, signifies to the Indian "plenty of fish." There is nothing to sustain life except the supplies, mostly of canned goods, which are brought from the towns of British Columbia or of the United States; and since the great rush of prospectors to these valleys, rich only in mineral wealth, food has commanded enormous prices. No article is sold for less than fifty cents, and a bag of flour or a peck of potatoes is sometimes considered a fair equivalent for several ounces of gold.

The Klondike is one of a number of creeks which empty into the Yukon, and gold is found in the gravel deposits which form the valleys through which these streams run. The richest finds have been on the Klondike and the Bonanza; but claims have been laid out also on Dominion, Indian, Hunter, Glacier, Miller, Eldorado and Gold Bottom Creeks. This is nearly all in British territory. But we have gold fields just across the border in our own Territory of Alaska. There are paying mines at Circle City on the Yukon, at Forty Mile, at the junction of Forty Mile Creek with the Yukon, and probably on other streams to the south.

The discovery of the wonderful deposits in the Klondike region appears to have been made in August, a year ago, by George Cormack. Evidently he was not succeeding at "Forty Mile," which is on the Yukon, in Alaska, and strolled across the border on a prospecting tour. He found gold in paying quantities near the junction of the Bonanza and Klondike Creeks, and returned to Forty Mile for help. With two Indians he was able to "pan out" about $500 a week. The news was slow in reaching Circle City, a large camp of miners about two hundred miles lower down on the Yukon. Perhaps they did not believe the first reports. At all events, it was December before any movement was made. Then in one day Circle City was depopulated and a new city, Dawson, was established at the mouth of the Klondike, on the Yukon. There was a mad rush for the new country. Immediately it was all staked out. Along every stream and in every gulch claims were marked off, and with feverish haste the work of thawing the gravel was begun. There was then no water to wash the dirt with; but they could not wait for summer to loose the streams, so some of them made "rockers" and tunneled and "rocked" the earth and found it full of gold.

The stories of how gold was taken in winter and the present summer everybody has read. One man worked a hundred feet of his claim, took out $100,000, refused $200,000 for the rest of it, and started for California. He got as much as $212 from one pan of dirt. He washed out, on the average, $250 an hour. Two men took out $6,000 in one day. Some made no attempt to work their claims, but sold them for moderate fortunes. One miner, who dug down to bed-rock, found that the lowest stratum was lined with gold dust and nuggets. The rock was full of V shaped seams, and every seam contained a clay rich with gold. One of the miners had his wife with him, and she carried gravel to their hut by the panful, and washed it. She took out on her own account $6,000 during the winter. Another woman, not oppressed with household cares or the demands of society, picked up several thousand dollars' worth of nuggets on the dumps—a nice little sum of pin money. Four young men cleaned up $40,000, and a Michigan man, with a few helpers, made $94,000 out of his winter's work. But he had a hard time of it at first. He settled on the Klondike alone. For a place to sleep and keep his provisions he dug a hole in the ground. Every day he tramped about vainly looking for gold. His back was a mass of sores from the heavy pack he carried, and his feet were frozen and blistered. For six weeks he did not see one of his own kind. One day he found a little stream flowing down the mountain side and emptying into a basin. The water was only partly frozen. It was shallow, and at the bottom his aching eyes suddenly caught the gleam of gold. Leaping into the icy water, he began to snatch up the golden nuggets. He worked with wild excitement, and carried the gold to his hut, where he buried it for fear of thieves. He toiled this way until spring and had his fortune. Everybody got gold. If they had no claim and no money to buy one, they got work at from $15 a day up to $50; for labor was scarce. A young man "panned out" $40,000 in two days. Almost every miner got a fortune. Nearly all were poor when they went there, but many came away rich. A deck watchman on one of the river steamers spent a few months on the Klondike, and came to San Francisco with $150,000.

These stories, which seem fabulous, are known to be true. The gold has been brought back and put in banks and assay offices and with trust companies. The miners brought it in carpet bags, sacks, oil cans, old tomato cans, boxes, belts and other queer receptacles. It is estimated that $3,000,000 was taken out in the Yukon district in 1895, nearly $5,000,000 in 1896 and that the yield for 1897 will be over $10,000,000.

The mines are what are known as placer mines, and gold is obtained in the form of dust and nuggets. The largest nugget found so far was worth about $250 and was about the size of an ordinary potato. This is small compared with the nuggets found in Australia and California. The Victorian mines produced a single mass of gold worth $41,000 and weighing 146 pounds avoirdupois, while California broke the record with a lump weighing 186 pounds. California gold is richer than the Klondike metal, having a smaller percentage of silver, lead and other metals. It is the quantities that Klondike yields that makes it one of the most famous gold regions known to the world. Another remarkable feature of the new Eldorado is that none of the claims worked so far has proved a blank. The best claims are those on the Klondike, which empties into the Yukon, the Bonanza, a tributary of the Klondike, and the Eldorado, which flows into the Bonanza. The gold region is believed to embrace Circle City and Forty Mile, Alaska, and the Klondike region south to Stewart River; and it is reasonably certain that we shall yet have large mineral wealth from our Alaskan territory to compensate us for the gradual loss of the fur seal industry.

The great question since the discoveries has been how to get to Klondike. The stream of travel follows two routes principally. Taking steamer at Seattle, Washington, Vancouver or Victoria, British Columbia, you go west to the southwestern extension of Alaska, passing from the Pacific Ocean through Unimak Strait into Bering Sea, and thence to St. Michael Island, some ninety miles above the mouth of the Yukon. There are light draught river steamers which will take you up the Yukon to the gold fields, distant about 2,000 miles. Counting the sea voyage from Seattle to St. Michael, 3,500 miles, makes the gold region some 5,500 miles away by this route. Another route, shorter by at least 2,500 miles, is by steamer from Seattle or Tacoma to Sitka, thence to Juneau and to Dyea, which is on Chilkoot Inlet, at the foot of Chilkoot Pass. From Chilkoot Pass to the Klondike it is about 600 miles. Crossing the mountains is a difficult and hazardous feat. To get over the pass requires an ascent of 4,000 feet, and much of the rise is so precipitous that a single misstep may mean sudden destruction. From the pass the way lies through a chain of five lakes—Lindemann, Bennett, Tagish, Marsh and Labarge—and thence to the head waters of the Yukon. Part of this hard journey is overland, and has frequently to be made through melting snows. Dangerous cataracts are encountered in the boat passage on the lakes, and many wrecks bear witness to the necessity of skillful piloting down the swift currents to Miles Cañon and the White Horse Rapids,

ON THE SUMMIT OF CHILKOOT PASS.

frequently called "the Miner's Grave." This, being a third shorter than the St. Michael route, is selected by ninety out of every hundred miners, notwithstanding its great hardships and perils, for they are naturally in a hurry to get at the nuggets.

Still another way of reaching Klondike is over the White Pass, from Juneau. Ocean steamers can land at the foot of the pass on Skaguay Bay, about eighty-five miles from Juneau. The pass is not difficult. It is 1,000 feet lower than Chilkoot, and it is in contemplation to build a railroad over it to Teslin Lake, a distance of only about thirty-five miles. Light draught steamers will run from Teslin Lake to Grand Canon, around which a road may be built. From the foot of the canon steamers may easily reach all the mining settlements. Within a few months this route will probably be the favorite one, and, of course, a telegraph line will connect Dawson City with the rest of the world at an even earlier date.

And so a trip to the Klondike gold fields may soon be an ordinary vacation tour. For gold is wealth, and wealth men covet, and think no enterprise too great or hazardous to get it. But at present it is no vacation tour; and the hazard is so great that only the strongest and the best equipped should risk starving or freezing to death.

For the article and map we are indebted to the Independent and for our illustrations to the Wave, of San Francisco, Cal.

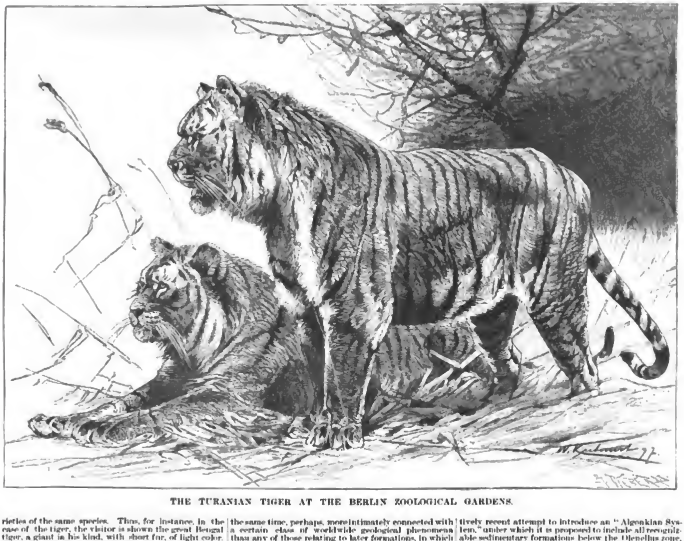
THE TURANIAN OR ARAL TIGER IN THE ZOOLOGICAL GARDENS AT BERLIN, GERMANY.

THE Berlin Zoological Gardens have for some time endeavored to bring before the public geographical varieties of the same species. Thus, for instance, in the case of the tiger, the visitor is shown the great Bengal tiger, a giant in his kind, with short fur, of light color, the dark stripes fairly wide apart; then the Sunda tiger, as found in Malacca and the great Sunda Islands, much smaller than his Bengal relative, of low stature, dark color, and close striped, long fur. He has a bushy beard and often rudiments of a mane. Then, again, there is the Siberian tiger, from the valley of the Amoor River. He resembles the Bengal tiger in his massive body, but differs widely from him in his soft woolly coat and his arm-thick tail.

Quite recently the gardens have received a most interesting addition to their stock in a pair of Turanian or Aral tigers. These are altogether a novelty. There we have the color and the marking of a tiger, but not a tiger's build. The body is comparatively short and deep. The head, particularly of the male, is so short that one is almost inclined to believe that this is a case of accidental deformity. The thick, long coat, which is almost shaggy in some regions, somewhat obliterates the marks, such as the tiger of the tropics shows them. Similarly, the stripes on the tail are somewhat indistinct and irregular. The short mane and the pointed beard forcibly remind us of the Sunda tiger.

Regarding the peculiar formation of the face, Herr Hagenbeck, who imported the animals, asserts that not only the Persian tiger, but also the Persian lion is thus distinguished, and he intends to prove the truth of his assertions by further importation. Scientific literature seems to offer some indications showing that the fossil tiger of the Siwalik Hills (Felis cristata) was similarly flat faced.

Little is known about the new inhabitants of the Berlin Zoological Gardens, except that they reached their present abode via Tiflis, and that probably they are natives of the Aral-Caspian region. A comparison of the animals with some furs obtained by Von Humboldt in those parts, and presented to the Berlin Museum, seems to justify this supposition. Of other zoological institutions, that of St. Petersburg, with its rich stock of Asiatic curiosities, is the only one that is likely to be able to furnish any parallel to these Aral tigers. The appearance of these, and a pamphlet published about them by Mr. Matchie, has created some sensation among zoologists and paleontologists, as supplying some clew in the long debated question on the cave lion and the cave tiger, the remains of which are often found in diluvial strata of Württemberg and other places. For our engraving and the foregoing description we are indebted to the Illustrirte Zeitung.



THE TURANIAN TIGER AT THE BERLIN ZOOLOGICAL GARDENS.

THE BRITISH ASSOCIATION—ADDRESS IN GEOLOGY.

THE address in Section C was delivered by Prof. G. M. Dawson, C.M.G., F.R.S., who said: The nature and relations of the more ancient rocks of North America are problems particularly Canadian, for these rocks in their typical and most easily read development either constitute or border upon the Continental Protaxis of the north. The questions involved are, however, at the same time, perhaps, more intimately connected with a certain class of worldwide geological phenomena than any of those relating to later formations, in which a greater degree of differentiation occurred as time advanced. A reasonably satisfactory classification of the crystalline rocks beneath those designated as Paleozoic was first worked out in the Canadian region by Logan and his colleagues—a classification of which the validity was soon after generally recognized. The greatest known connected area of such rocks is embraced within the borders of Canada; and if I mistake not, the further understanding of the origin and character of these rocks is likely to depend very largely upon work now in progress or remaining to be accomplished here. Although it is intended to speak chiefly of the distinctively pre-Cambrian rocks of Canada, and more particularly of the crystalline schists, it will be necessary also to allude to others, in regard to the systematic position of which differences of opinion exist. Of the Cambrian itself, as distinguished by organic remains, little need be said; but it is essential to keep in touch with the paleontologically established landmarks on this side, if for no other reason than to enable us to realize in some measure the vast lapse of time, constituting probably one of the most important breaks in geological history, by which the Cambrian and its allied rocks are separated from those of the Huronian and Laurentian systems. In attempting to review so wide a subject, and one upon which so much has already been written, the chief difficulty is to determine how much may be legitimately eliminated while still retaining the important features. This must be largely a matter of individual judgment, and I can only hope to present what appear to me to be the essential points, with special reference to the geology of Canada. The useful object of any such review is, of course, to bring out what may now actually be regarded as established respecting these older rocks, and in what direction the most hopeful outlook exists for improving our knowledge of them. For this purpose, the best mode of approaching the subject in the first place, and up to a certain point, is the historical one; and it will thus be desirable to recapitulate briefly the first steps made in the classification of the crystalline schists in Canada.

Having done that, Dr. Dawson concluded: In thus rapidly tracing out what appears to me to be the leading thread of the history of the pre-Cambrian rocks of Canada, and in endeavoring to indicate the present condition of their classification, and to vindicate the substantial accuracy of the successive steps taken in its elaboration, many names and alternative systems of arrangement proposed at different times, by more or less competent authorities, have been passed without mention. It has also been my object, in so far as possible, by omitting special reference to divergent views, to avoid a controversial attitude, particularly in respect to matters which are still in the arena of active discussion, and in regard to which many points remain admittedly subject to modification or change of statement. But, in conclusion, and from the point of view of Canadian geology, it is necessary to refer—even at the risk of appearing controversial—to the comparatively recent attempt to introduce an "Algonkian System," under which it is proposed to include all recognizable sedimentary formations below the Olenellus zone, assumed for this purpose to be the base of the Cambrian. If in what has already been said I have been able correctly to represent the main facts of the case—and it has been my endeavor to do so—it must be obvious that the adoption of such a "system" is a retrograde step, wholly opposed, not only to the historical basis of progress in classification, but also to the natural conditions upon which any taxonomic scheme should be based. It not only detaches from the paleozoic great masses of conformable and fossiliferous strata beneath an arbitrary plane, but it unites these, under a common systematic name, with other vast series of rocks, now generally in a crystalline condition, and includes, as a mere interlude, what, in the region of the Protaxis at least, is one of the greatest gaps known to geological history. In this region it is made to contain the Keweenawan, the Animikie, the Huronian, and the Grenville series, and that without in the least degree removing the difficulty found in defining the base of the last mentioned series. It thus practically expunges the result of much good work, conducted along legitimate lines of advance during many previous years, with only the more than doubtful advantage of ena-

bling the grouping together of many widely separated terranes in other districts where the relations have not been even proximately ascertained. It is, in effect, to my mind, to constitute for geology what was known to the scholastic theologians of a former age as a limbo, appropriate as the abode of unjudged souls and unbaptized infants, that might well in this case be characterized as "a limbo large and broad." It is not intended to deny that there may be ample room for the introduction of a new system, or perhaps, indeed, of an entire geological æon between the Huronian, as we know it in Canada, and the lowest beds which may reasonably be considered as attaching to the Cambrian, or even to the Paleozoic as a whole. On the contrary, what has already been said will, I think, show that in the region of the Protaxis we might very reasonably speak of an "Algonkian hiatus," if we elect so to call it. Elsewhere it will undoubtedly be possible, sooner or later, to designate series of rocks laid down during the time represented only by orogenic movements and vast denudation in the province here more particularly referred to, but before any general systematic name is applied to such terranes they should be defined, and that in such a way as to exclude systems already established as the result of honest work.

THE MOUNT ETNA OBSERVATORY.

ETNA, the largest volcano of Europe, in the form of an imposing isolated cone, one and three-quarter miles in height and eighteen miles wide at the base, is situated upon the eastern coast of Sicily, eighteen miles to the north of Catania. Its summit nearly touches the limit of perpetual snow, and, consequently, in all seasons except summer, the upper portion of the mountain is covered with a mantle of snow of greater or less extent, and the temperature is very cold there. At the bottom, on the contrary, the climate is mild, and there is a varied and luxuriant vegetation consisting of species belonging to both subtropical and cold countries. In fact, in ascending, we met with cactuses, orange and olive trees, grapevines, wheat, chestnut trees, pines, ferns, etc., up to 6,500 ft., after which there is nothing but rocks, volcanic sand and snow. The foot of Etna is one of the most picturesque of regions, and one of the most fertile and populous in the world, despite the threatenings and dangers of the volcano. In the highest part the snow and hail are in perpetual contrast with the heat and fire of the volcano. Usually, the burning materials ejected by Etna melt the snow. Thus, in the winter and spring of 1888, the craters and the lava of the eruption of 1892, that is to say, several months after their cooling, were seen standing out in dark relief against the white background of snow that covered the mountain.

But it requires a stratum of volcanic ashes to protect the snow from the burning heat of the lava at a temperature of 1,000°, so that the latter may not flow over the snow without melting it, except in small quantity. This was observed in the eruption of 1879. This protective or isolating action of the volcanic products has an important industrial application in the commerce of the snow that is preserved, either naturally in the ancient extinct eruptive material or in the artificial trenches that are covered with volcanic sand.

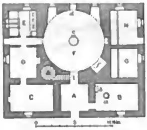


FIG. 1.—Ground Floor Plan of the Etna Observatory: A. Entrance. B. Geodynamics: a, tromometer; b, seismoscopes. C D. Alpine lodgings. E. Kitchen. F. Hall: c, seismic clock. G H. Stable. I. Stairway to the first story. First Story: F. Refractor room. D. Meteorological window; photography. E. Keeper. E. Workshop. G. Bedroom. H. Second room.

From the summit of Etna there is a superb view of 130 miles radius over almost the whole of Sicily, Malta and the Æolian Islands, because the air, reduced to nearly a third of its density, is of extreme transparency.

Etna has long periods of calm, during which the abundant eruptions of steam are rare, and the earth, even near the central crater, at the observatory, is entirely quiet, and does not disturb the most sensitive seismic apparatus.

It may be said that the summit of Etna is an astronomical and meteorological station, placed under exceptionally favorable conditions. At intervals of a few years, this peace is interrupted by terrible paroxysms in which the mountain and its surroundings are violently shaken. The volcano usually opens at the sides, vomits up its contents, throws out blocks that are sometimes 30 cubic feet in volume, and ejects torrents of incandescent lava that enters, burns and buries the forests, vineyards and fields that it meets with in its fatal flow of several miles. Usually, from the summit of Etna, it is possible to follow these grand phenomena, which develop beneath the feet of the observer.

The utility and interest of placing a refuge for visitors and a station for special geological, seismological and geophysical studies upon the summit may be readily seen.

M. Ricco, the learned director of the two observatories of Catania and Etna, who has published such fine works upon this establishment and upon the meteorology of this region, has been kind enough to send us the photographs that illustrate the following note by M. H. Faye, the illustrious dean of French astronomers.

This observatory, says M. Faye, was constructed according to the ideas of Prof. Tacchini, in view of special researches without continuity. It was restored in 1891, after disasters caused by the elements and the eruption of 1886. At present there are in place an equatorial of 18 ft. focal length and various meteorological and seismological instruments. Observations are made here regularly, save in winter, the epoch at which eruptions are inevitable.

This year either a telegraph or telephone line will be run at least as far as to Nicolosi, and this will permit of rendering the work regular. The spot is reached from Catania by a road passable for vehicles as far as to Nicolosi (2,300 ft.), and by mule road up to Casa del Bosco (4,700 ft.), and to the Alpine meteorological station (6,140 ft.), and then by more or less visible and practicable footpaths.

FIG. 2.—ALPINE METEOROLOGICAL STATION HALF WAY BETWEEN NICOLOSI AND THE ETNA OBSERVATORY.

FIG. 3.—CENTRAL CRATER OF ETNA AND VULCAROLO SEEN FROM THE OBSERVATORY (SOUTH).

In summer persons come by mule up to the very door of the observatory. In winter the mules very rarely go beyond Casa del Bosco, and the rest of the journey is performed upon the snow, which is usually soft and fatiguing to walk over. The observatory is then buried under 6 to 15 ft. of snow, so that it has to be entered through a window in the first story. It may be said that the enemy is not the volcano, but the snow. Moreover, there is no mountain sickness from which one cannot rid himself by habituation.

The position of the observatory is as follows:

Altitude	9,650 feet.
Latitude	37° 44′ 3″
Longitude, east	2° 33′ 8″ (Rome).

FIG. 4.—THE ASTRONOMICAL OBSERVATORY ON THE SUMMIT OF ETNA (9,652 FEET).

It is situated at about half a mile from the southern edge of the central crater, which is 10,860 ft. in height, and, consequently, overlooks the observatory 1,216 ft. to the north-northwest.

From the meteorological observations made since 1892, the following data have been obtained:

	Mean temperature.
Winter	— 0·6°
Spring	— 1·5°
Summer	+ 7·3
Autumn	+ 2·7
Year	+ 0·4°

Annual means of other meteorological data:

Pressure	558·9 mm.
Tension of vapor	3·2 "
Relative humidity	65
Prevailing wind	N.E.
Precipitation	37 days.

The calculated temperature of the summit should be 3·2° lower than that noted at the observatory. The direct measurement of such temperature gives 0·6° more. This is the effect of reheating due to the crater.

The spectroscopic observations have given the following averages, reduced to the normal mass of the atmosphere traversed:

	Observatories. Etna.	Catania.
Thickness of the atmospheric band, a	1·7	1·4
Intensity of the zone, δ	0·5	0·1
Intensity of the rain band	0·5	1·2

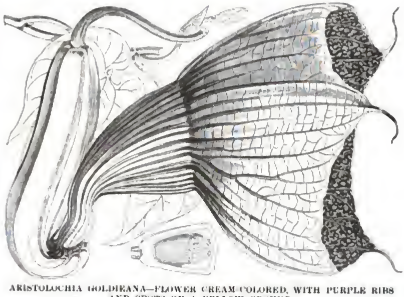
Electric manifestations upon Etna are rare and occur mainly in autumn. It is not certain that lightning has struck the Casa Inglese once since 1810.

The Etna observatory, which is built over that old hut, has never been struck, although there is no lightning rod, and the great metallic mass of the cupola and roof are deprived of all communication with the ground. This rareness does not seem to depend upon that of the aqueous vapor, since upon the Alps, where such vapor is still rarer, there are often imposing electric manifestations. With Etna, we certainly have to take into account the protective action of the central crater, the great plume of smoke and hot steam of which acts silently like a gigantic lightning protector. —La Nature.

FIG. 5.—ETNA AND THE OBSERVATORY AS SEEN FROM THE CATANIA OBSERVATORY.

ARISTOLOCHIA GOLDIEANA.

ONE of the most extraordinary flowers in bloom in the Victoria house, Kew, is this West African species. The flower is naturally pendulous, or nearly so, the lower part of the tube is irregularly cylindrical, cream-colored, smooth, and bent upward nearly at a right angle into a funnel-shaped upper half. This part of the tube is marked with prominent purple ribs, and expands into a bowl-shaped three-lobed limb, strongly marked with purplish ribs, the three lobes prolonged into acuminate points; the interior of the bowl is yellowish, thickly marbled with velvety purplish brown spots. The entire flower is as large as one's hat, and very striking in appearance, just one of those interesting plants which the floral committee would pass over as of no commercial value. Although in point of size, form and color it is very attractive, we cannot say so much for its odor.—Gardeners' Chronicle.



ARISTOLOCHIA GOLDIEANA—FLOWER CREAM-COLORED, WITH PURPLE RIBS AND SPOTS ON A YELLOW GROUND.

EXPLORATIONS OF THE UNIVERSITY OF PENNSYLVANIA IN BABYLONIA.*

THIS fine volume, to be followed by its mate, telling the story of the first great expedition for excavation in old Babylonia, sent from the United States by the University of Pennsylvania, is not published by the university, as might have been expected, but by a New York firm. With a good deal of confidence we assume that the reason is that Dr. Peters, as director of that expedition, having left his position as a teacher in the university to become the rector of a large New York church, in lineal succession to his father and grandfather, does not care to have his work supervised by the scholar, no matter how able, who edits for the university its publications on the expedition, and who was, during the years here described, his subordinate. Dr. Peters can thus speak with a certain freedom which has its advantages and disadvantages.

Dr. Peters was the natural leader of this expedition. He was not only active in proposing the preliminary Wolfe expedition to Babylonia, in the years 1884-85, led by Dr. Ward, but by interesting Bishop Potter, and through him Miss Catherine Wolfe, in the subject, he secured the $5,000 which made that expedition possible. It was Dr. Peters' energy which secured the funds for a more ambitious expedition, through liberal friends of the University of Pennsylvania, with which Dr. Peters was then connected as professor of Hebrew, as well as with the Episcopal Seminary in Philadelphia. To these public-spirited gentlemen, among whom we may mention the brothers E. W. and C. H. Clarke, he dedicates this volume.

Dr. Ward had rapidly visited all the important sites in Babylonia, with the exception of Sifr, Larsa and Abu Sharein, and had specially recommended Niffer or Nuffar (the ancient Nippur) as a site for exploration by an American expedition. After full study Dr. Peters selected this site for excavation, and its name is given to this volume. Work has been carried on there since 1889, the first two years under Dr. Peters.

It is the story of these first two years which Dr. Peters is to tell, only the first year's story being in this volume. The succeeding years belong to the self-denying work of Mr. J. H. Haynes, who remained alone on the hill with his Arabs summer and winter, and whose volume of description, edited very fully by Dr. Hilprecht, is in preparation, to be published by the university. Two volumes of texts discovered by the expedition have already been issued by Dr. Hilprecht, and have proved of the first importance historically.

The first year was one of disappointment and disaster. The funds were freely supplied; tried assistants were secured in the persons of Mr. Haynes and Mr. D. Z. Noorian, interpreter and director of the workmen, both of whom had accompanied the Wolfe expedition, and two young Assyriologists, Dr. Hilprecht and Dr. R. F. Harper—really one too many—and Mr. P. H. Field as architect and surveyor. With them, at his own expense, was Mr. J. Dyneley Prince, who went as far as Bagdad, where he was compelled by sickness to leave the expedition. Dr. Peters is frank enough to say:

"Our first year at Nippur had ended in failure and disaster. I had failed to win the confidence of my comrades. None of them agreed with me in my belief in the importance of Nippur, and the desirability of excavating down to the foundations. The Arabs had proved treacherous. The Turkish authorities disbelieved our story of Arab treachery, and suspected us of plotting with our Turkish commissioner to carry away antiquities. I was sick and nervous, having suffered for two months almost incessantly from severe facial neuralgia and consequent sleeplessness. In fact, I was on the verge of collapse, and the world had never seemed quite so black before."

Indeed, things were black. An Arab thief had been shot by their Turkish soldier. Dr. Peters had mistakenly refused to pay blood money. The Arabs had burned their camp and robbed them of twelve hundred dollars in gold; they were escaping in danger of their lives, some of their horses having been burned. Turks as well as Arabs were hostile. All the American members had sent in their resignations. Dr. Peters was recalled to Philadelphia, and the whole expedition was likely to be given up and to end in failure. It is to the great credit of the gentlemen connected with the university that they decided to continue another year with a smaller force, consisting only of Dr. Peters, Mr. Haynes and Mr. Noorian. The result of that decision was a success which has received the warmest recognition of the best European scholars. It is useless to deny that the disaster of the first year—apart from the failure to reach the valuable antiquities—was due in part to inexperience, and in part to what is included under the general term of incompatibilities. Success in dealing with Arabs requires knowledge of their character, and an avoidance of any apparent suspicion of them. The lack of these conditions has wrecked not a few expeditions in which young, eager and positive men have been thrown into relations intimate enough to produce other than friendly feelings. This volume suggests and sometimes exposes the personal infelicities of the first year. Some words about Dr. Peters' companions might quite as well have been omitted. We shall be surprised if they do not provoke unpleasant rejoinders.

Of the difficulties experienced in securing a firman we need not speak. Most of the volume is taken up with the story of the delay in Constantinople and the journey down the Euphrates, along routes traversed by many travelers. The one important discovery recorded is the identification of Kal'at Dibse with the biblical Tiphsah and the classical Thapsacus. This, we believe, is new, and needs, as Dr. Peters suggests, further investigation, especially as of the four consonants in Tiphsah only one appears in Dibse, which has precisely the consonants of the Hebrew and Arabic word for honey or sirup, so that one would naturally suppose Kal'at Dibse to mean the Village of Date Sirup, Dibse being for dibs. Yet that the corruption might come by volksetymologie from Tiphsah we would not deny, if the locality fits as well as is said.

It is not an eventful story which Dr. Peters tells of his trip down the Euphrates. It is a region traveled over by many armies and many voyageurs, but no one yet has explored it, as Edward Robinson did Palestine, with a previous knowledge of the entire history and literature of the region, Greek and Arabic, so as to be able on the spot to know what old sites are to be located. The most careful subsequent study in libraries will not compensate for the cursory traveler's necessary ignorance at the time. Doubtless Dr. Peters would be glad to visit the country again with better educated eyes. As it is he has supplemented his necessarily hasty notes of daily movement with historical and geographical information derived chiefly from Ainsworth, Chesney, Procopius, etc. Strangely, he does not find Cernik of any value, and does not mention him except briefly in an appendix. We should have supposed his "Studien-Expedition" to be of the highest value topographically, as its map is certainly the best we have of this part of the valley. There were no adventures more exciting than one of the company falling into the Euphrates, nothing certainly so serious as Ainsworth's being left behind by his steamer and having to walk fifty miles under the guidance of Arab robbers before he overtook his party.

The real interest of the volume begins, of course, near its end, when the party reached Niffer and began their excavations. Sixty pages are given to the two and a half months which constituted the first campaign that ended so disastrously, the camp burned, the money stolen, the Arabs furious, almost nothing discovered, the expedition broken up by the resignation of its members, and its director recalled to Philadelphia. Perhaps a fuller account of these dozen weeks would have been interesting, even at the expense of reducing the observations about Constantinople and the journey, but the scientific results, which were secured the next year, will come in the second volume. The failure of the first year, which Dr. Peters can afford

* "Nippur; or, Explorations and Adventures on the Euphrates." The Narrative of the University of Pennsylvania Expedition to Babylonia in the years 1888-1890. By John Punnett Peters, Ph.D., Sc.D., D.D., Director of the Expedition. With illustrations and maps. Volume I, First Campaign. 8vo, pp. xv, 375. G. P. Putnam's Sons, New York.

distinctly to acknowledge, had its causes, which he has partly intimated, and, we judge, partly withheld. Each member of the expedition would tell his own story. Dr. Peters, on whom the chief responsibility rested, deserves the credit of great determination and of the final victory over difficulties. He was able to go back the second year, conquering all adverse circumstances, and with fewer companions achieved at last a great success. The story he tells is of much interest, and the volume a valuable addition to the history of Oriental exploration.

We are not quite satisfied with the illustrations; but it is not Dr. Peters' fault that so many of the photographs taken in his expedition failed to develop. Most of the valuable pictures are from the photographs of the previous Wolfe expedition, for which general credit is given in the introduction. Of the other pictures we note as specially interesting the framework of an Affech hut of reeds and mats and one of the two pictures of the excavations.

In an appendix, following the Turkish irade authorizing the expedition, and other documents, are sixty pages of extracts from Dr. Ward's diary, taken on the Wolfe expedition. It was his intention to prepare a volume on that expedition, which was solely one of rapid survey, to learn whether such an expedition as that led later by Dr. Peters would be feasible, and to recommend sites for exploration. Other duties prevented him from carrying out his literary purpose, and he put his diary at the service of Dr. Peters, who was compelled to abridge it, omitting diagrams and what seemed to him less important, but retaining the numerous records of angular bearings taken from the various mounds, which ought to be of great value in constructing a map, inasmuch as no map exists of value for the region south of that so carefully plotted by Collingwood and Bewsher.—The Independent.

[Continued from Supplement, No. 1131, page 18082.]

ADDRESS BY SIR JOHN EVANS,

K.C.B., D.C.L., LL.D., Sc.D., Treas. R.S., V.P.S.A., For. Sec. G. S.; Correspondant de l'Institut de France, etc.; President of the British Association for the Advancement of Science.*

In his address to this association at the Bath meeting of 1864, Sir Charles Lyell struck so true a note that I am tempted to reproduce the paragraph to which I refer:

"When speculations on the long series of events which occurred in the glacial and post-glacial periods are indulged in, the imagination is apt to take alarm at the immensity of the time required to interpret the monuments of these ages, all referable to the era of existing species. In order to abridge the number of centuries which would otherwise be indispensable, a disposition is shown by many to magnify the rate of change in prehistoric times by investing the causes which have modified the animate and inanimate world with extraordinary and excessive energy. It is related of a great Irish orator of our day that when he was about to contribute somewhat parsimoniously toward a public charity, he was persuaded by a friend to make a more liberal donation. In doing so he apologized for his first apparent want of generosity by saying that his early life had been a constant struggle with scanty means, and that 'they who are born to affluence cannot easily imagine how long a time it takes to get the chill of poverty out of one's bones.' In like manner we of the living generation, when called upon to make grants of thousands of centuries in order to explain the events of what is called the modern period, shrink naturally at first from making what seems so lavish an expenditure of past time. Throughout our early education we have been accustomed to such strict economy in all that relates to the chronology of the earth and its inhabitants in remote ages, so fettered have we been by old traditional beliefs, that even when our reason is convinced, and we are persuaded that we ought to make more liberal grants of time to the geologist, we feel how hard it is to get the chill of poverty out of our bones."

Many, however, have at the present day got over this feeling, and of late years the general tendency of those engaged upon the question of the antiquity of the human race has been in the direction of seeking for evidence by which the existence of man upon the earth could be carried back to a date earlier than that of the quaternary gravels.

There is little doubt that such evidence will eventually be forthcoming, but, judging from all probability, it is not in northern Europe that the cradle of the human race will eventually be discovered, but in some part of the world more favored by a tropical climate, where abundant means of subsistence could be procured and where the necessity for warm clothing did not exist.

Before entering into speculations on this subject or attempting to lay down the limits within which we may safely accept recent discoveries as firmly established, it will be well to glance at some of the cases in which implements are stated to have been found under circumstances which raise a presumption of the existence of man in pre-glacial, Pliocene or even Miocene times.

Flint implements of ordinary paleolithic type have, for instance, been recorded as found in the eastern counties of England, in beds beneath the chalky bowlder clay; but on careful examination the geological evidence has not to my mind proved satisfactory, nor has it, I believe, been generally accepted. Moreover, the archæological difficulty that man, at two such remote epochs as the preglacial and the postglacial, even if the term glacial be limited to the chalky bowlder clay, should have manufactured implements so identical in character that they cannot be distinguished apart, seems to have been entirely ignored.

Within the last few months we have had the report of worked flints having been discovered in the late Pliocene forest bed of Norfolk, but in that instance the signs of human workmanship upon the flints are by no means apparent to all observers.

But such an antiquity as that of the forest bed is as nothing when compared with that which would be implied by the discoveries of the work of men's hands in the Pliocene and Miocene beds of England, France, Italy, and Portugal, which have been accepted by some geologists. There is one feature in these cases which has hardly received due attention, and that is the isolated character of the reputed discoveries. Had man, for instance, been present in Britain during the Crag period, it would be strange indeed if the sole traces of his existence that he left were a perforated tooth of a large shark, the sawn rib of a manatee, and a beaming full face carved on the shell of a pectunculus!

In an address to the Anthropological Section at the Leeds meeting of this association in 1890 I dealt somewhat fully with these supposed discoveries of the remains of human art in beds of tertiary date; and I need not here go further into the question. Suffice it to say that I see no reason why the verdict of "not proven" at which I then arrived should be reversed.

In the case of a more recent discovery in Upper Burma in beds at first pronounced to be upper Miocene, but subsequently "definitely ascertained to be Pliocene," some of the flints are of purely natural and not artificial origin, so that two questions arise: first, Were the fossil remains associated with the worked flints or with those of natural forms? And second, Were they actually found in the bed to which they have been assigned or did they merely lie together on the surface?

Even the Pithecanthropus erectus of Dr. Eugène Dubois from Java meets with some incredulous objectors from both the physiological and the geological sides. From the point of view of the latter the difficulty lies in determining the exact age of what are apparently alluvial beds in the bottom of a river valley.

When we return to paleolithic man, it is satisfactory to feel that we are treading on comparatively secure ground, and that the discoveries of the last forty years in Britain alone enable us to a great extent to reconstitute his history. We may not know the exact geological period when first he settled in the British area, but we have good evidence that he occupied it at a time when the configuration of the surface was entirely different from what it is at present; when the river valleys had not been cut down to anything like their existing depth, when the fauna of the country was of a totally different character from that of the present day, when the extension of the southern part of the island seaward was in places such that the land was continuous with that of the continent, and when in all probability a far more rainy climate prevailed. We have proofs of the occupation of the country by man during the long lapse of time that was necessary for the excavation of the river valleys. We have found the old floors on which his habitations were fixed, we have been able to trace him at work on the manufacture of flint instruments, and by building up the one upon the other the flakes struck off by the primeval workman in those remote times we have been able to reconstruct the blocks of flint which served as his material.

That the duration of the paleolithic period must have extended over an almost incredible length of time is sufficiently proved by the fact that valleys some miles in width and of a depth of from 100 to 150 feet have been eroded since the deposit of the earliest implement-bearing beds. Nor is the apparent duration of this period diminished by the consideration that the floods which hollowed out the valleys were not in all probability of such frequent occurrence as to teach paleolithic man by experience the danger of settling too near to the streams, for had he kept to the higher slopes of the valley there would have been but little chance of his implements having so constantly formed constituent parts of the gravels deposited by the floods.

The examination of British cave deposits affords corroborative evidence of this extended duration of the paleolithic period. In Kent's cavern at Torquay, for instance, we find in the lowest deposit, the breccia below the red cave earth, implements of flint and chert corresponding in all respects with those of the high level and most ancient river gravels. In the cave earth these are scarcer, though implements occur which also have their analogues in the river deposits; but, what is more remarkable, harpoons of reindeer's horn and needles of bone are present, identical in form and character with those of the caverns of the reindeer period in the south of France, and suggestive of some bond of union or identity of descent between the early troglodytes, whose habitations were geographically so widely separated the one from the other.

In a cavern at Creswell Crags, on the confines of Derbyshire and Nottinghamshire, a bone has, moreover, been found engraved with a representation of parts of a horse in precisely the same style as the engraved bones of the French caves.

It is uncertain whether any of the river drift specimens belong to so late a date as these artistic cavern remains; but the greatly superior antiquity of even these to any neolithic relics is testified by the thick layer of stalagmite, which had been deposited in Kent's Cavern before its occupation by men of the neolithic and bronze periods.

Toward the close of the period covered by the human occupation of the French caves there seems to have been a dwindling in the number of the larger animals constituting the quaternary fauna, whereas their remains are present in abundance in the lower and therefore more recent of the valley gravels. This circumstance may afford an argument in favor of regarding the period represented by the later French caves as a continuation of that during which the old river gravels were deposited, and yet the great change in the fauna that has taken place since the latest of the cave deposits included in the paleolithic period is indicative of an immense lapse of time.

How much greater must have been the time required for the more conspicuous change between the old quaternary fauna of the river gravels and that characteristic of the neolithic period!

As has been pointed out by Prof. Boyd Dawkins, only thirty-one out of the forty-eight well ascertained species living in the postglacial or river drift period survived into prehistoric or neolithic times. We have not, indeed, any means at command for estimating the number of centuries which such an important change indicates; but when we remember that the date of the commencement of the neolithic or surface stone period is still shrouded in the mist of a dim antiquity, and that prior to that commencement the river drift period had long come to an end; and when we further take into account the almost inconceivable ages that even under the most favorable conditions the excavation of wide and deep valleys by river action implies, the remoteness of the date at which the paleolithic period had its beginning almost transcends our powers of imagination.

We find distinct traces of river action from 100 to 200 feet above the level of existing streams and rivers, and sometimes at a great distance from them; we observe old fresh water deposits on the slopes of valleys several miles in width; we find that long and lofty escarpments of rock have receded unknown distances since their summits were first occupied by paleolithic man; we see that the whole side of a wide river valley has been carried away by an invasion of the sea, which attacked and removed a barrier of chalk cliffs from 400 to 600 feet in height; we find that what was formerly an inland river has been widened out into an arm of the sea, now the highway of our fleets, and that gravels which were originally deposited in the bed of some ancient river now cap isolated and lofty hills.

And yet, remote as the date of the first known occupation of Britain by man may be, it belongs to what, geologically speaking, must be regarded as a quite recent period, for we are now in a position to fix with some degree of accuracy its place on the geological scale. Thanks to investigations ably carried out at Hoxne, in Suffolk, and at Hitchin, in Hertfordshire, by Mr. Clement Reid, under the auspices of this association and of the Royal Society, we know that the implement-bearing beds at those places undoubtedly belong to a time subsequent to the deposit of the great chalky bowlder clay of the eastern counties of England. It is, of course, self evident that this vast deposit, in whatever manner it may have been formed, could not, for centuries after its deposition was complete, have presented a surface inhabitable by man. Moreover, at a distance but little farther north, beds exist which also, though at a somewhat later date, were apparently formed under glacial conditions. At Hoxne the interval between the deposit of the bowlder clay and of the implement-bearing beds is distinctly proved to have witnessed at least two noteworthy changes in climate. The beds immediately reposing on the clay are characterized by the presence of alder in abundance, of hazel, and yew, as well as by that of numerous flowering plants indicative of a temperate climate very different from that under which the bowlder clay itself was formed. Above these beds characterized by temperate plants, comes a thick and more recent series of strata, in which leaves of the dwarf Arctic willow and birch abound, and which were in all probability deposited under conditions like those of the cold regions of Siberia and North America.

At a higher level and of more recent date than these—from which they are entirely distinct—are the beds containing paleolithic implements, formed in all probability under conditions not essentially different from those of the present day. However this may be, we have now conclusive evidence that the paleolithic implements are, in the eastern counties of England, of a date long posterior to that of the great chalky bowlder clay.

It may be said, and said truly, that the implements at Hoxne cannot be shown to belong to the beginning rather than to some later stage of the paleolithic period. The changes, however, that have taken place at Hoxne in the surface configuration of the country prove that the beds containing the implements cannot belong to the close of that period.

(To be continued.)

* Delivered at Toronto, August 18, 1897.

[Continued from Supplement, No. 1131, page 18081.]

EDWARD DRINKER COPE, NATURALIST.*

VII.

Cope was not satisfied with the study of morphological details or simple taxonomy. He aspired to know how animals came into existence; why they varied as they did, and what laws determined their being. His was an eminently philosophical mind, but at the same time with a decided tendency to metaphysical speculation. In one of his earliest papers he manifested this tendency and it persisted through life. It is with much hesitation that I venture to give an exposition of his most salient views, for I must confess I do not altogether like his philosophy and am able to subscribe to it only in part. I cannot but wish that one of his numerous disciples could have been chosen for this task. But I must not pass it by, for it is the most characteristic feature of Cope's work and the one he most esteemed.

Cope began his public scientific career, it will be remembered, in the same year in which Darwin's long studies had fructified into his "Origin of Species."

As was quite natural with his keen instincts, Cope early adopted the doctrine of transmutation of species and recognized the truth that all the animals of the present epoch are descendants from those of past times with modifications which separate them as species, and eventually as representatives of genera, of families and orders differing from the earlier ones as we retrace the steps of Time farther and farther back. He was not, however, satisfied with Darwin's theory, and denied that natural selection was a sufficient factor for differentiation. He would not admit that animals were passive subjects and that the slight variations which were manifest in the progeny of species were sufficient to enable Nature to select from and to fit for future conditions. He contended that the volition and endeavors of an animal had much to do with future progeny as well as its own brief life. In short, he claimed that characters acquired by animals through their own efforts or forced on them by various external agencies or accidents might be transmitted to their offspring. He further, first in a chapter in his "Synopsis of the Cyprinidæ of Pennsylvania" outlined, and later, in "The Origin of Genera," he elaborated a peculiar theory characterized mainly by what he called (with Prof. Hyatt) "the law of acceleration and retardation" in development. Darwin complained that he could never understand this law, and Cope complained that Darwin had not stated his views correctly in an attempted abstract. I therefore give Cope's views, restated in his own language, summarizing them years afterward. "The following doctrines," he says, "were taught:"

"First, that the development of new characters has

* Presidential address by Prof. Theodore Gill before the annual meeting of the American Association for the Advancement of Science, August 9, 1897.

been accomplished by an acceleration or retardation in the growth of the parts changed. This was demonstrated by reference to a class of facts, some of which were new, which gave ground for the establishment of the new doctrine.

"Second, that of exact parallelism between the adult of one individual or set of individuals and a transitional stage of one or more other individuals. This doctrine is distinct from that of inexact parallelism, which had already been stated by Von Baer. And that this law expresses the origin of genera and higher groups, because,

"Third, they can only be distinguished by single characters when all their representatives come to be known.

"Fourth, that genera and various other groups have descended, not from a single generalized genus, etc., of the same group, but from corresponding genera of one or more other groups. This was called the doctrine of homologous groups.

"Fifth, the doctrine that these homologous groups belong to different geological periods, and,

"Sixth, to different geographical areas, which, therefore, in some instances, are,

"Seventh, related to each other in a successional way like the epochs of geological time.

"Of these doctrines it may be observed that the first and second are now the common property of evolutionists, and are recognized everywhere as matter of fact. The names which I selected to express them have, however, only come into partial use. The author believes that, although the doctrine was vaguely shadowed out in the minds of students prior to the publication of this essay, it had not previously been clearly expressed nor been reduced to a demonstration. Of the truth of the doctrine the author is more than ever convinced, and he believes that paleontological discovery has demonstrated it in many instances, and that other demonstrations will follow. The fourth proposition (that of homologous groups) is now held as a hypothesis explaining the phylogeny of various groups of animals. For the descent of one homologous group from another, the term polyphyletic has been coined. It remains to be seen whether the doctrine is of universal application or not. That homologous groups belong to different geological horizons, as stated under the fifth head, has been frequently demonstrated since the publication of the essay. That the sixth proposition is true in a certain number of cases is well known, and it follows that the seventh proposition is also true in those cases. The latter hypothesis, which was originally advanced by Prof. Agassiz, is, however, only partially true, and the advance of paleontological study has not demonstrated that it has had a very wide application in geological time.

"A proposition which was made prominent in this essay was that the prevalence of non-adaptive characters in animals proves the inadequacy of hypotheses which ascribe the survival of types to their superior adaptation to their environment. Numerous facts of this kind undoubtedly indicate little or no activity of a selective agency in nature, and do point to the existence of an especial developmental force acting by a direct influence on growth. The action of this force is the acceleration and retardation appealed to in this paper. The force itself was not distinguished until the publication of the essay entitled 'The Method of Creation' [1871], where it was named growth force, or bathmism. The energetic action of this force accounts for the origin of characters, whether adaptive or non-adaptive, the former differing from the latter in an intelligent direction, which adapts them to the environment. The numerous adaptive characters of animals had by that time engaged the attention of the author, and he found that they are even more numerous than the non-adaptive. Some of the latter were accounted for on the theory of the 'complementary location of growth force.'"

We can only consider the "law of acceleration and retardation." Again it behooves us to seek his own definition:

"a. The succession of construction of parts of a complex was originally a succession of identical repetitions; and grade influence merely determined the number and location of such repetitions.

"b. Acceleration signifies addition to the number and location of such repetitions during the period preceding maturity, as compared with the preceding generation, and retardation signifies a reduction of the number of such repetitions during the same time."*

His meaning may best be inferred from his application to mankind. This was done in the following terms in 1872:†

"Let an application be made to the origin of the human species. It is scarcely necessary to point out at the start the fact, universally admitted by anatomists, that man and monkeys belong to the same order of mammalia, and differ in those minor characters generally used to define a 'family' in zoology.

"Now, these differences are as follows: In man we have the large head with prominent forehead and short jaws; short canine teeth without interruption behind (above); short arms, and thumb of hand not opposable. In monkeys we have the reverse of all these characters. But what do we see in young monkeys? A head and brain as large relatively as in many men, with jaws not more prominent than in some races; the arms not longer than in the long-armed races of men, that is, a little beyond half way along the femur, . . . At this age of the individual the distinctive characters are therefore those of homo, with the exception of the opposable thumb of the hind foot and the longer canine tooth. . . .

"Now in the light of various cases observed, where members of the same species or brood are found at adult age to differ in the number of immature characters they possess, we may conclude that man originated in the following way; that is, by a delay or retardation of growth of the body and fore limbs as compared with the head; retardation of the jaws as compared with the brain case, and retardation in the protrusion of the canine teeth."

There is good reason for thinking that fallacy is involved in this argument and that quite a different interpretation should be put on the evolution of the characters in question. It is not the fore limbs that are retarded in man, but the hind limbs have become enlarged (compare the adult and the infant). There is not retardation of the jaws, but a special teleological adaptation. Man has for the most part at least discontinued the use of his teeth for warfare, and as a result of diminished use the canines have become reduced and the diastemata of the dental series been obliterated. The brain has grown after birth and become enlarged, and as a consequence the brain case has extended forward—the reverse of what occurs in the apes. Concomitantly with the diminished use of the teeth and jaws, the masseter and temporal muscles have become reduced and the sagittal and lambdoidal ridges have consequently become atrophied. The ecarinate rounded voluminous calvarium is the result.

It has been claimed that the young of higher species "are constantly accelerating their development." In man, however, development is retarded, inasmuch as infancy and juvenility are prolonged far beyond the periods observed in our simian relatives.

Such examples as this give cause to believe that the "law of acceleration and retardation" has been at least unduly extended. Acceleration and retardation are, however, to a large extent, terms which express facts of evolution; whether the word law is applicable may depend on the meaning one gives the word.

The transmission of acquired characters was one of the accepted and most cherished dogmas of Cope, and the belief in transmissibility of such characters is an essential of the creed of so many who have become his followers in America that a special school came into existence known as the Neo-Lamarckian and also as the American school. My own prejudices have inclined me to that school. Nevertheless, when I have divested myself of such prejudices as well as I could, I have been compelled to admit that the evidence of the heredity of acquired characters was rather weak. There was, indeed, evidence for, as well as against, but that against the doctrine of the transmissibility of acquired characters seems to be the most weighty.

It is to be understood that the acquired characters considered in this connection are such as have been developed during postnatal life as a result of endeavors of the animal or of the influence of external agencies. The evidence presented has been mostly in support of the contention that the characters acquired have been directly inherited by offspring, and consequently the transition from the form not possessing the character to one having it is rapid. The evidence adduced has not been conclusive, to say the least. There is, apparently, a germ of truth in the proposition that acquired characters are transmitted, but in a modified sense, and the case has been weakened rather than strengthened by the evidence offered.

The evidence for inheritance of acquired characters was frequently given by Cope, and in his last published work, "The Primary Factors of Organic Evolution," he marshaled the testimonies of many witnesses with his accustomed skill. He evoked "evidence from embryology," "evidence from paleontology," "evidence from breeding;" he considered the "characters due to nutrition," "characters due to exercise of function," "characters due to disease," "characters due to mutilation and injuries," and "characters due to regional influence;" he inquired into "the conditions of inheritance," and he fought against the "objections to the doctrine of inheritance of acquired characters." I have gone over all this evidence and yet I have not been convinced that the contention has been sustained that characters acquired during the external life of an animal are transmitted. Many cases are alleged to sustain the "inheritance of characters due to mutilation and injuries." Some of these may be considered as mere coincidences; others provoke skepticism for one reason or other. To discuss them would be out of place here. But at least we may meet evidence with counter evidence.

On the one hand, all the data and experiments recapitulated in the cases enumerated concern only two, or at most very few, generations of the animals in question, and were within the compass of a single man's lifetime.

On the other hand, we have data and observations of the most reliable nature, and of an extraordinary compass. These have resulted not from experiments for the determination of a specific question, but from observances of a religious character. They were really in the nature of surgical operations, but for our purpose may be looked upon as experiments and have the value of contrived experiments. In no other field has such a series of disinterested experiments been available. They were conducted on countless millions of mankind and for thousands of years. The subjects experimented upon were kept isolated from others alike by their own prejudices and the prejudices of their neighbors. Circumcision is the term applied to the experiments in question.

For about 4,000 years circumcision has been practiced on a gigantic scale. Every male child among the Jews was operated upon, not only in Palestine, but wherever representatives of the race had wandered and adhered to their religion; religion itself was involved in the operation and it was regarded as a holy rite; the most scrupulous attention was paid to details. The operation was performed eight days after birth, and consequently there could be no functional activity of the tissues concerned. But after 4,000 years the new-born boys of the race come into the world with the special integument developed as much as in those of other races. Even the principle of atrophy through disuse has not become manifest in the case.

Other evidence, it seems to me, is the result of confounding the potentiality of a function with its manifestation. I allude to one set of examples on account of the interest of the cases, and I do so with the deference due to the eminence and ability of the gentleman who has furnished the evidence. That evidence has been collected under the head of "inheritance of characters due to the exercise of function." The evolution of the American trotting horse was considered. It was recorded that "by 1810 the t[illegible]e for trotting as a sport had . . . increased [illegible] in 1818 it became a recognized sport under [illegible] rules. . . . At the end of 1824, six years [illegible] first accepted three-minute record, the rec[illegible] fallen to 2:34. . . . . By 1848 the record wa[illegible] to 2:29½; the next decade lowered the reco[illegible]nds. . . . Finally, at the close of 1896, the re[illegible] been further lowered to 2:03¾." It is deduced from these premises that "there is nothing whatever in the actual phenomena observed anywhere along the line of this development of speed that would lead us to even suspect that the changes due to exercise of function had not been a factor in the evolution." But to me it seems that there is no evidence to show that the speed attained was other than would have resulted from taking the same animals untrained and then speeding the last. The speed is, of course, simply the expression of functional adaptation, and the horses were selected merely because, by their manifestation, they showed that they had the co-ordination of structural and psychological characters needed for the manifestation of the function. The manifestation guided the breeder to the selection of the animals. The successful animals were the pick of thousands unknown to fame.

But there is much in the history of the development of animals that seems to lead to the belief that eventually modifications may be due in part to acts of representatives of the phylum to which they belong. It is difficult to believe that some structural features are simply the result of natural selection operating on chance variations. An application of the doctrine of chances to some such cases appears to be adverse to the conception that they represent the influence of natural selection unaided.

A feature characteristic of most cave animals of widely diverse groups and classes is the atrophy of the eyes, and it seems to be most logical to attribute this to disuse of those organs in remote progenitors, and to assume that the atrophy may have resulted from a failure of nourishment by the nutrient fluid of the organs on account of the loss of functional activity rather than to selection by nature of forms with successively diminishing eyes. The presence of eyes in most cases certainly would scarcely be an element of disadvantage to animals, and it may be allowable to invoke some other agency than chance selection. We may be justified in postulating that the continuous disuse of the organs would in time react on the nutrition of the parts affected, and finally atrophy or disappearance would result. Like explanation would be applicable to the innumerable cases of atrophy of parts known to the naturalist.

But if cessation of nutrition culminates in final atrophy, increased nutrition of parts may result in hypertrophy and increased nutrition may be the concomitant of increased activity of parts. The exercise of such parts continued for many generations may react on the organization and the progeny at length be affected thereby. Of such cases Cope adduced many examples. The feet of the horse line furnish illustrations. The existing horse has the median toes and hoofs greatly hypertrophied and the lateral ones atrophied, but the remote ancestors had feet of nearly the same general pattern as the rhinoceroses and tapirs. Atrophy of the lateral digits has progressed inversely to hypertrophy of the middle ones. An analogous line of development culminating in feet superficially much like those of the horse was followed by another quite remote family of hoofed mammals, the Prototheriids of South America.

The idea of acceleration and retardation was associated by Cope with the idea that the course of evolution was determined from the beginning of things, and that life, to use his own words, is "energy directed by sensibility or by a mechanism which has originated under the direction of sensibility." He maintained that "consciousness as well as life preceded organism," and he called this conception "the hypothesis of archæsthetism." This idea I refer to especially because it was broached in his vice-presidential address, delivered at the meeting of the American Association for the Advancement of Science, in Philadelphia, in 1884.*

I am myself unable to comprehend consciousness except as a product or result of organization, and those who wish to learn more about Cope's views respecting the question must refer to one of his many papers.

Whatever may be thought of Cope's philosophical views, his presentation of them is always interesting and some of them are illustrated with a wealth of facts that renders his communications valuable as repertories of well digested information. His first special paper, on "The Origin of Genera," published as early as 1868, is especially noteworthy for the mass of morphological data contained in it and for the apt manner in which they are tabulated.

VIII.

I venture to conclude with some reflections on the rank that may be assigned to Cope in the world of Science.

Among those that have cultivated the same branches of science that he did—the study of the recent as well as the extinct vertebrates—three naturalists have acquired unusual celebrity. Those are Cuvier, Owen and Huxley.

Cuvier excelled all of his time in the extent of his knowledge of the anatomical structure of animals and appreciation of morphological details, and first systematically applied them to and combined them with the remains of extinct vertebrates, especially the mammals and reptiles. He was the real founder of vertebrate paleontology.

Owen, a disciple of Cuvier, followed in his footsteps, and, with not unequal skill in reconstruction and with command of ampler materials, built largely on the structure that Cuvier had begun.

Huxley covered as wide a field as Cuvier and Owen, and likewise combined knowledge of the details of structure of the recent forms with acquaintance with the ancient ones. His actual investigations were, however, less in amount than those of either of his predecessors. He excelled in logical and forcible presentation of facts.

Cope covered a field as extensive as any of the three. His knowledge of structural details of all the classes of vertebrates was probably more symmetrical than that of any of those with whom he is compared; his command of material was greater than that of any of the others; his industry was equal to Owen's; in the clearness of his conceptions he was equaled by Huxley alone; in the skill with which he weighed discovered facts, in the aptness of

* Proc. Am. Phil. Soc., 1871; Origin of Fittest, p. 142.

† Penn. Monthly Mag., 1872; Origin of the Fittest, p. 11, 1887.

* Origin of Fittest, p. 405.

his presentation of those facts, and in the lucid methods by which the labor of the student was saved and the conception of the numerous propositions facilitated, he was unequaled. His logical ability may have been less than that of Huxley and possibly of Cuvier. He has been much blamed on account of the constant changes of his views and because he was inconsistent. Unquestionably he did change his views very often. Doubtless some of those changes were necessitated by too great haste in formulation and too great rashness in publication. The freedom to change which he exercised, and which was exercised too little by at least one of his predecessors, was an offset to his rashness. He exercised a proper scientific spirit in refusing to be always consistent at the expense of truth.

His reputation at present is much inferior, at least among the people at large, to those of the men with whom he has been compared. Immediate reputation depends on various circumstances, some of which are quite adventitious, and it is often long before men find their true levels. It is scarcely premature to prophesy that Cope's reputation will grow, and that in the future history of science his place will be at least as large as that of any of his predecessors.

SOME ELECTRICAL SPORT.

By JAMES F. HOBART.

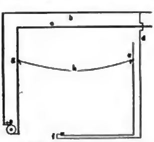
ALMOST any man feels better for having a joke once in a while, and the electrician is no exception to the old adage:

"A little nonsense now and then
Is relished by the best of men."

Electricity offers a vehicle for the conveyance of more uproarious fun to the square inch than anything else man is acquainted with, and it is very easy to rig up things in a dynamo room in such a manner as to more than astonish visitors that may drop in.

But this may be dangerous, especially where an arc light current is used, unless proper precautions are taken, and the young engineer or electrician who is prone to practical electric jokes should never try anything in this line that is new to him, unless he has first talked over the matter with an experienced electrician and fully discussed the matter with him. Such a course may prevent accident, and the experiments will not lose anything by having competent advice given.

Some things may be done which form very striking illustrations of electric energy and yet do not come strictly within the meaning of the words "sport" or "fun." In Fig. 1, let a represent an arc dynamo and b



AN ELECTRIC FLASH LIGHT.

and c the leads that pass to the lamps outside the dynamo room. Take off a branch wire as shown at d. Lead this wire to a convenient part of the room and terminate it with the small hook shown at e. A switch, f, may be located at any convenient part of the room. In a rig put up by the writer it was located in the floor, close to the engine, where a man would naturally stand when attending to that machine.

The negative lead had its insulation removed at g, and another hook attached there. A piece of No. 36 copper wire was stretched from one hook to the other as at h.

The length of wire must be determined by experiment. If too long, the experiment will be unsuccessful. About 15 to 20 feet will be about right for a first trial. Arrange the hooks so the wire will hang just above the head of the tallest person likely to come under it.

By closing the circuit at f, the current will flow through the fine wire, and if the voltage is high enough, the wire will be burned with a flash like that of lightning. It forms a very striking experiment in the heating of conductors, and if 15 or 20 feet of wire is burned just above the heads of visitors, some of them, especially the ladies, are apt to be heard from at once.

By putting in a wire heavy enough so that the dynamo cannot flash it instantly, the expansion of metals will become apparent, as the wire will sag 2 or 3 feet when current is turned on before it gets hot enough to burn. If the size and length of wire be gaged just right, current can be turned on and the wire will stretch to its limit and contract again when current is cut off. Or, by making short contacts carefully, the fine wire can be stretched and contracted and then burned with a flash at will. In a following article an account will be given of how some street urchins were cured of hanging around an electric light station.—American Electrician.

To Clean Paintings.—To clean an oil painting, take it out of its frame, lay a piece of cloth moistened with rain water on it, and leave it for awhile to take up the dirt from the picture. Several applications may be required to secure a perfect result. Then wipe the picture very gently with a tuft of cotton wool damped with absolutely pure linseed oil. Gold frame may be cleaned with a freshly cut onion; it should be wiped with a soft sponge wetted with rain water a few hours after the application of the onion, and must finally be wiped with a soft rag.—Der Stein der Weisen.

ELECTRIC TRACTION AT PARIS.

ELECTRIC traction is not making rapid progress in Paris. While in foreign countries and in country towns we daily see new installations of electric tramways established and very rapidly developed, we remain in Paris with a few lines provided with accumulator cars and with a single line having contacts with the surface of the earth. The question of aerial or subterranean conductors is, in fact, of high importance, and does not seem as yet upon the point of being solved.

Meanwhile we shall make known the new arrangements adopted by the Society of Tramways, of Paris, and the Department of the Seine for the lines that run from the Madeleine to Courbevoie, to Courbevoie-Neuilly and to Levallois, and that have the respective lengths of 4, 4½ and 3½ miles.

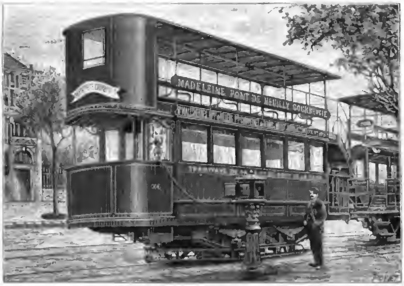


FIG. 1.—VIEW OF A CAR IN THE PROCESS OF BEING CHARGED.

The system adopted is electric propulsion by rapidly charged accumulators. The charging is effected in a few minutes and during the period of stoppage at the termini of the road.

The installation that we are about to describe was made by the Société Industrielle de Moteurs Electriques et à Vapeur.

The generating works are established at Quai National, at Puteaux. They contain three Babcock & Wilcox multitubular boilers capable of furnishing 3,960 pounds of steam per hour at a pressure of 245 pounds to the square inch. These boilers supply three Willans triple expansion steam motors, each directly actuating a four pole Brown dynamo of 300 amperes and 600 volts at an angular velocity of 400 revolutions a minute. The steam engines are capable of running with escapement in open air or condensation. The water necessary for the condensation and the supply of the boilers is taken from the Seine by a pump actuated by an electric motor.

Fig. 3 gives an internal view of the engine room of the works. To the left are situated the three groups of motors with coupled dynamos, and to the right the distributing board. Each dynamo is connected with a special panel by a circuit that traverses two circuit breakers and a bipolar interrupter.

From the distributing bars start six feeders, one of which is designed for supplying the charge to the depot, two for actuating the electric pumps and assuring the lighting, and the three others for charging the cars at a distance. Each of the circuits traverses upon the board an automatic lever interrupter, an ampere meter and two circuit breakers.

Of the three feeders, one, of a section of 0·25 square inch, does duty for the charging station at Courbevoie-Neuilly; the second, of 0·25 square inch section, is connected with Courbevoie (Place Victor Hugo); and the third ends at Levallois, upon the edge of the Seine. They are formed of lead-covered cables placed directly on the ground.

At each charging station there is installed a post of a form analogous to that of fire alarms. The feeders are connected with a small internal board, and a collector permits of putting the post in connection with the car (Fig. 1).

The cars have a seating capacity for 52 passengers and are double decked. Each weighs in running order 14 tons and is capable of hauling a trailer of 7 tons. It contains 200 Tudor accumulators, each with five 42 pound plates placed under the seats in hermetically closed boxes. Fig. 2 gives a view of the space beneath the seats in which the accumulators are placed.

The charging is done with a constant difference of potential. The battery, all the elements of which are mounted in tension, is put in communication with the charging station through a small board that may be seen in front in Fig. 2. The mean intensity of the charge is 120 amperes and the duration from 10 to 12 minutes.

Each car is provided with two motors of 25 horse power, each revolving 500 times a minute and actuating each of the two axles through a steel pinion and a cast iron wheel. The running speed allowed by the regulations is 9½ miles an hour outside of Paris and 7½ miles

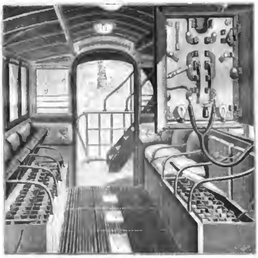


FIG. 2.—INTERNAL VIEW OF A CAR, SHOWING THE DISTRIBUTING BOARD AND ARRANGEMENT OF THE ACCUMULATORS.

within. Let us add that the car is provided with a controller that permits of effecting all the maneuvers and suppressing a battery, if an accident should happen. Upon a normal run all the accumulators are coupled in tension. In addition to the rope brake maneuvered by the winch of the controller, each car is provided with screw brakes and sand boxes. The car is lighted with six electric lamps branched in tension upon the battery. Two small electric fans serve for driving to the exterior the gases disengaged during the charging.

These few data, although very incomplete, show us

that it is a question in Paris of an interesting experiment that will give an idea of the practical value of propulsion by means of Tudor accumulators. Some interesting results have already been obtained at Hanover. —La Nature.

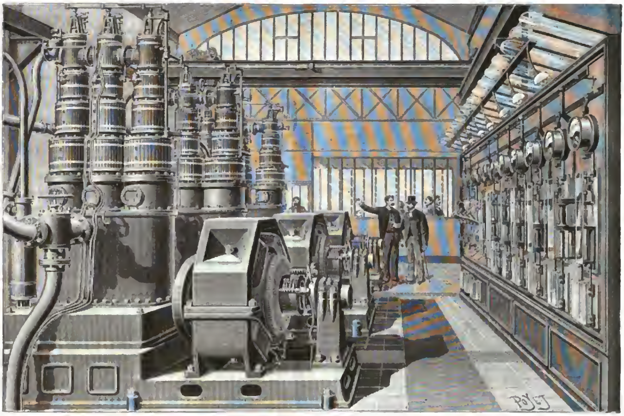


FIG. 3.—INTERNAL VIEW OF THE MACHINERY HALL OF THE WORKS FOR THE PRODUCTION OF ELECTRIC ENERGY.

LIGHTHOUSE PROGRESS, 1887-1897.

IN 1887 some account was given in Nature of lighthouse work and progress in the United Kingdom during the preceding fifty years. I propose in this article to consider briefly the same subject in connection with the past ten years, so that the whole may form a summary record of what has been attained during the Victorian era in this important branch of optical and mechanical science.

And, first, it may be asserted that the period of the Queen's reign, distinguished as it is for so many developments of new industries, can boast of none more valuable or more interesting than this now in question. Fresnel's monumental invention in 1819 of the dioptric system of lights was at once welcomed and realized by the French government, who have since always encouraged and supported the native constructors of lenticular apparatus. But it was only after thirty years from this date that the lighthouse industry was planted in England, if we except the experimental attempts of Messrs. Cookson, of Newcastle. The systematic and permanent establishment is due to the public spirit and the enterprise of Messrs. Chance Brothers, subsequently aided by the mathematical talents and personal direction of Mr. James T. Chance, whose services to the Royal Commission on Lights of 1860, as well as to the Trinity House, and whose writings on lighthouse optics, are widely known. It is said that great pecuniary loss resulted from the first efforts of Messrs. Chance, but they have gone on steadily and alone to the present day, with little or none of official aid or encouragement, and they are certainly entitled to full credit for having done so much and so well for the coast illumination of their own country and the world.

I adopt the main divisions of the former articles, viz., Towers, Apparatus, Lamps.

There is not much to be noted in regard to the architecture or engineering features of the iron and stone lighthouses erected in Britain during the past ten years. The principal island towers are in the Shetlands, viz., Stroma, Fair Island, and Sule Skerry, which is one of the dangerous reefs known as skerries so thickly strewn on the northern and western coasts. These all are the successful works of Messrs. D. and C. Stevenson. The Trinity House has not erected any rock or pile tower since the Round Island in 1887.

Of lightships there have been established two only, which are at the mouth of the Thames to mark the Edinburgh Channel, and, like all the Trinity lightships, they have 21 inch silverplated reflectors, with the powerful two-wick oil burners of Sir J. Douglass, the flash from one face of the light being equal to 20,000 candles.

To nearly all the light vessels in our waters sound signals, chiefly of the siren type, have been added, which are invaluable in the frequent sea fogs that beset our shores, since by a marvelous beneficence of nature —for the proof of it we are chiefly indebted to the researches of Tyndall—fog that quenches light deepens the intensity of sound. The siren is now an indispensable adjunct to our principal land lights, and a visit to the Isle of May, the St. Catherine's, or Ailsa Craig, would well repay any one desirous of seeing the latest and best arrangements for the production and transmission of its weird and inimitable notes.

Many of our land lights and floating lights have been connected with the main telegraphic system "for life-saving purposes only." There were, at the end of 1896, 27 such stations in England and Wales, 14 in Scotland, and 11 in Ireland. The most suitable places were selected for the observation of passing vessels and for the immediate transmission of reports of casualties to the nearest points available for help. It is by no means an easy work to make a durable telegraphic connection with a lightship, and with all stations the cost is considerable; but the benefit is so marked that this communication, long and urgently demanded, will soon be extended to all other sites on the coast where the advantage is evident, and the difficulty not insurmountable.

Of the new sea lights in the decade under review may be mentioned the Girdleness, the Rattray Head, the Tarbetness, the Stroma, the Seaddon, the Skroo, and the Sule Skerry, all on the Scottish coast, and the Round Island, the St. Catherine's electric, the Spurn Point, and the Withernsea, on the English coast. The characteristics of several older lights of fixed sections have been changed, such as the Whitby, Coquet, Orfordness, Southwold, and Needles, which have been made occulting lights.

To complete the bare statistics of the subject, it may be mentioned that the whole number of lights of all sorts and sizes on the coasts of the United Kingdom on December 31, 1896, according to the Admiralty List, was 1,095, an increase of about 200 over the number of ten years ago. Of the 1,095 lights, not more than 11 or 12 per cent. may be classed as of sea power, and 6 or 7 per cent. as lightships. The rest are port, harbor and pier lights, showing a very abundant supply of local signals apart from the great coast signals controlled by the three Lighthouse Boards.

It would seem, indeed, that the programme of coast lighting is almost completed—at least as regards England. A powerful oil light is to be erected by the Trinity House in St. Mary's Isle, on the northeast coast, and two others in Lundy Isle in the Bristol Channel, where also, at Lynmouth, an electric light is proposed. A further improvement in the fine reflector light of Beachy Head is also spoken of. The Northern Commissioners will erect a first-class light at Noup Head, in the Orkneys, and another on the Flannan Islands in the Hebrides. For Ireland no new light appears to be intended for the present; but the improvement of the Fastnet, the most outlying of our lights westward, must soon be taken in hand.

The lantern which crowns the tower and protects the apparatus of a land or rock lighthouse has been materially improved in its construction. The perfect lantern is of adequate area to contain the light and accessory parts, and afford convenient space for service. Its diameter for a sea light is rather 14 feet than 12 feet. It is of circular form throughout, having a cast iron pedestal of sufficient height to carry an inside and an outside gallery for cleaning purposes. The framing is of gun metal or wrought iron. The half inch plate glass of the purest quality, while resisting wind and weather to a great extent, intercepts the least possible light from the lenses. There is provided abundant ventilation to sustain the central lamp, and refresh the keepers. The best contribution of the Trinity House to the structure has been the large cylindric ventilator on the double copper dome, by which the last named advantage is mainly secured.

Turning to the optical features of the decade, let us see what changes have affected the two main factors of illumination—the fixed light and the revolving light. The ever-increasing number of ships and ports, and the sustained demand for greater and greater speed of vessels, and for sea signals that shall serve more and more to meet all conditions of weather and to discriminate harbors and channels of approach, have stimulated the efforts of lighthouse engineers in the two directions of power and distinctiveness.

The characteristics introduced of late years have been confined for the most part to new combinations and periods of group flashes, or of single equal flashes. Mixed lights of fixed and revolving sections, and therefore with unequal degrees of visibility, are no longer in good repute, although, in the French service especially, they are still retained. Color also is being gradually abandoned for sea lights. For harbor lights, however, it is still freely resorted to, most of all in Northern Europe, as in the Oland light, Baltic Sea, where in one small apparatus there are no fewer than six characteristics with seventeen variations.

Power has been sought:

(1) By the substitution, wherever practicable, of annular for cylindric lenses, or of revolving for fixed sections.

(2) By the longer focal distance and larger condensing surface of these lenses, and by superposing them in vertical series.

(3) By using an illuminant of maximum intensity, whether oil, gas, or electricity.

(4) By certain variations and extensions of the Fresnel refractors, giving a higher coefficient of beam.

(5) By invoking the principle of the full perception of the light from an annular lens moving in rapid rotation with very short intervals between the flashes. This is known as the feu éclair.

(6) By rotating an opaque screen around a lamp, or by raising and lowering quickly an opaque cylinder, or by cutting off and relighting of gas in rapid alternation.

Let us consider these in order.

(1) The reasons for the disuse of fixed sea lights, except in the case of marking or intensifying particular sectors, are chiefly their want of power to penetrate to their natural horizon, and the increasing number of bright fixed lights on ships and on shore, which may in certain conditions lead a navigator into danger from the difficulty of distinguishing them from a lighthouse. The flashing light, with its superior power and numerous possible distinctions, is the best safeguard against this.

(2) The hyper-radial lens of 1,330 millimeters focal distance, first suggested (as Prof. Tyndall declared) by Mr. John Wigham, and concurrently at least by Mr. Thomas Stevenson, who less fitly termed it hyper-radiant (a good name for the ten wick oil flame, or ten ring gas flame), has quite justified the expectation of lighthouse engineers as a convenient and powerful instrument admirably adapted to the large burners now employed. This lens, like its predecessor of 920 millimeters radius, is commonly used without catadioptric prisms, as in the Spurn Point light. The disuse of prisms effects a great saving in cost at but an inconsiderable diminution of power where a high vertical angle of refraction is adopted. Yet it must be admitted that this is at the expense of symmetry and elegance. The French light on Cape d'Antifer is a fine example of the hyper-radial system, embracing a full complement of prisms.

There has also been constructed, at Mr. Wigham's

suggestion, as an experiment, what he aptly calls a giant lens of 2,000 millimeters radius, but it is not yet adopted in practice.

The superposition of lens lights, each with its own burner, is an obvious means of gaining power, and it is remarkable that, although first suggested in 1859, it was not practically utilized with dioptric apparatus until 1872. Whether biform, triform, or quadriform arrangements be resorted to, the advantage of concentrating or reducing the intensity of the beam according to atmospheric variations is inestimable, and the adaptation reflects undoubted credit on Mr. John Wigham, whose polyannular gas burner on a like plan had been already approved. The triform Tory Island light, fitted with these burners, and variable in power from 17,500 to 393,500 candles, may be cited in illustration.

(3) The maximum intensity of an illuminant must still be sought in the electric arc. Gas and oil remain substantially equal compared in lamps of the same size and sort, the superior applicability of each being determined by local conditions. In Ireland the Wigham expanding burners give a marked prominence to the gas, which is copiously used in them. In England and Scotland mineral oil is preferred, its quality being carefully maintained at the highest standard. The old disability of this illuminant, the risk of explosion, has been almost nullified by the production of a petroleum whose flashing point is 230°, and long experience has confirmed its great value. On the other hand, the gas called "incandescent" has been introduced, the best form of it being of the Auer-Welsbach type. The brilliancy of this gas is perhaps only second to that of the electric arc, but the perishable character of its accessories exacts great caution in using it, and it has not as yet been employed in any sea light in this country, although it is already so adopted in France. A mixture of oxygen and coal gas, and one of oxygen and oil vapor, which have been tried in street lamps and otherwise, have been recommended for lighthouses, but not hitherto accepted.

Electricity has been, as it were, on its trial since the South Foreland experiments of 1885, and the evidence affecting it is hardly yet complete enough to justify a final verdict. The result established at the South Foreland was that the electric light is the most powerful under all conditions of weather, and has the greatest penetrative intensity in fog. The committee of the Royal Society, which examined in 1890 this report of the Trinity House, found that the experiments did really justify the results given.

The twelve years that have elapsed since the trials at the South Foreland have on the whole tended to qualify the conclusion as to the penetrative power in fog. Three lights—two of the group flashing and one of the single flashing character—constructed by Messrs. Chance, may be cited on this point. The triple flash of the Tino light (near Spezia) has been unmistakably discerned in rain and fog at a distance of more than twenty miles. On the other hand, the Isle of May light has been invisible in a thick atmosphere not amounting to fog, at a distance of twelve miles, and in a dense fog at half a mile; and the St. Catherine's light was equally invisible to the Eider before she grounded on the Atherfield ledges. It has been, indeed, asserted that the St. Catherine's has often been unseen at a quarter of a mile distance.

The truth appears to be that the electric light is very sensitive to atmospheric conditions, which are so many and so various, and that in thick weather it parts with its power in a much greater ratio than does a gas light, or even an oil light. There is a degree of fog which quenches the sun, while the large luminous surfaces of the superposed gas lenses project on the fog a reddish coloration, and the fog itself thus becomes a signal to the mariner when, as it were, in the words of Persius, "Pinguem nebulam vomuere lucernae." It would be most dangerous, however, for the mariner in a fog to approach the coast presuming on this quality of a light in whose vicinity he supposed himself to be. The lead, the anchor, the horn, should be his trust till the veil lifts, and the electric beam shines out in full splendor.

There has occurred no important change in the burners of sea lights. The Trinity House improved six wick, or rather five wick, remains, if not the largest, the best working oil burner, with a power of 800 candles. This is used generally for lights of the first and second order, while the four wick, with a power of 300, is used for third order lights, and the eight wick, of 1,200 candles, for hyper-radial lights. The lamp is of the "pump" or the "pressure" type, and contains from 10 to 100 gallons of oil. It is probable that, owing to considerations of space and economy, the gravity system may again be resorted to with enlarged reservoirs seated on the lantern roof. The electric arc is used with carbons of from 15 mm. to 65 mm. diameter and currents of from 50 to 400 amperes. The incandescent filament is not found equally appropriate. The luminous intensities obtained from the arc range from five to fifty thousand candles. Both direct and alternating machines are employed. The installations at St. Catherine's and the Isle of May are of the most complete character, and do honor to the distinguished engineers of the Trinity House and the Northern Commissioners.

It may be mentioned that for positions difficult of access, lamps having special wicks and reservoirs for oil or gas, capable of burning from ten to thirty days, are now in use, though, of course, these are only available for small isolated lights.

(4) The improvements since 1887 in dioptric lights are few, and, with one exception, are of no striking importance. The great invention of Fresnel, perfected by the beautiful holophotal arrangements of Stevenson, has remained the cardinal principle of all modern lights of the lenticular type. But the inevitable tendency to modify and improve has resulted in several proposals of more or less merit. Mr. Alan Brebner had, in 1882, submitted an ingenious plan for producing vertical and azimuthal condensation by single agency in cases where straight prisms placed outside the main apparatus had been employed to intensify one or more sea sectors. This method, however, has been seldom, if at all, adopted. Again, Mr. Brebner, in 1884, had recommended a plan of dipping a portion of the beam to some intermediate distance between the lighthouse and the horizon to meet the case of a fog which the strongest beam can only very partially penetrate. This, or some analogous plan, has been tried, but has not prevailed. The advantage of withholding from the horizon a substantial part of the beam, and deflecting it anywhere, is extremely doubtful. The depth and direction of a fog are always uncertain elements. The lighthouse may be surrounded by it while the offing is clear, or vice versa. And it would be in equal measure mischievous to encourage the mariner to stand in, looking for a signal which he might never see, or see too late; and to intrust the lightkeeper with the power to deflect the light according to his own judgment. In 1892, Mr. Charles A. Stevenson published in Nature an account of his spherical and equiangular refractors which remedy a certain loss of emergent light in the Fresnel refractors. In 1894, Mr. Stevenson further developed his design, claiming for it, within practicable limits, an advantage of at least 10 per cent. in increase of light as compared with the Fresnel lens. The improved refractors have been adopted with success in several of the Scottish lighthouses. In 1895 and 1896, Mr. John A. Purves contributed an able mathematical analysis of equiangular prisms and a new form of spherical central lens, called the inverse refractor (the facets of the lens turned inward), to be used in connection with Mr. C. Stevenson's equiangular prisms. Messrs. Chance have raised the Fresnel lens from 57° vertical to 80°, using glass of the same refractive index, and this angle has been adopted by the Trinity House with great advantage.

(5) The one exception referred to in regard to the minor improvements of optical apparatus since 1887 is the "lightning light," an adaptation of serious importance which has attracted the attention of lighthouse engineers in nearly all maritime countries. The shortening of the interval between the flashes of a revolving light, so that the mariner, especially when in a fast liner, may have more speedy cognizance of the signal that guides him, has become a plain necessity, and led to the gradual reduction of the period from 60, 45 and 30 seconds to 20, 15, 10, and even 5 seconds, reducing proportionately the duration of the flash. So far the principle of the feu éclair has been approached. But much more than this is demanded. No one has advocated more strenuously than Lord Kelvin, himself a sailor and a benefactor of sailors, the acceleration of revolving lights. No one has laid it down more clearly that one-ninth or one-tenth of a second is sufficient for the eye to receive the full luster of a lens passing it. Any longer duration is a loss of time, and therefore of intensity. German and French physiologists have confirmed this, and it is the principle on which the feu éclair system is based. In its application, then, if for any "order" of light the maximum of power be desired, the largest available lens in vertical and horizontal angle, combined with a totally reflecting mirror and a central flame of adequate dimensions, must be adopted. If two or more lenses be used, singly or grouped, the intensity of each flash is proportionately less, the interval of time, say five seconds, between the single flashes or the groups of flashes being the same as where there is only one lens. In this manner the greatest intensity and the shortest interval are secured, and the characteristic as presented to the mariner seems theoretically perfect. The first general introduction of the "lightning light" is due to M. Bourdelles, the chief of the French lighthouse administration, under whose auspices several lighthouses on the coast of France have already been endowed with it. In England Messrs. Chance have constructed in 1895, for Cape Leeuwin, Western Australia, a "bivalve" apparatus of the first order, with an experimental duration of beam of one-fifth of a second, and they have placed, this year, in the exhibition of the Imperial Institute a "univalve," or one-lens apparatus, of the third order. Both these lights are on the feu éclair system.

Successful as this system appears to be, it should for the present be regarded as on its trial, and as awaiting the collective judgment of mariners on certain points. And meanwhile it should be estimated as supplementing, not displacing, the well tried forms of apparatus at the disposal of the lighthouse engineer.

A notable adjunct to the new rapidly rotating lights is the mercury float carriage, by which the effect of weight and friction is largely diminished. Another excellent quality of this arrangement is its suitableness for stations where earthquakes prevail, as it provides an elastic connection between the optical apparatus and the pedestal, instead of the rigid bearings in the older forms of carriage. If the Cammuilla lighthouse in Chile had been fitted with the mercury float, it is probable that it would not have been wholly ruined by the shock.

(6) The principle of occultation, that is, of interrupting the fixed beam of a cylindrical lens of an oil light by a dark shade moving round or over the flame, or in a gas light by cutting off the gas, is acknowledged to be of extreme usefulness, and has been applied to many of the fixed lights of our coasts. It is not that any power is really added to the light, but that the quick alternation of light and dark in various groups or periods imparts a quasi-intensity to the beam and a valuable set of characteristics for the mariner. The law of contrast has a physiological effect here, as it has in another manner with the feux éclairs. It is an extreme example, but it rests on trustworthy evidence, that the occulting light of Ventotene Island, near Naples, which is of the sixth order only, has been seen from a distance of nineteen miles, its normal range being nine miles. Using the words of Cicero with another application, it may be truly said, "Eo magis elucet quo magis occultatur."

Investigations into the amount of light reflected and transmitted by certain kinds of glass—lighthouse glass among the rest—have been most ably conducted by Sir John Conroy, Bart., at Oxford, in 1888. He traversed by newer methods and with surer results the ground of many observers, from Augustin Fresnel to Lord Rayleigh; and he demonstrated that "the values of the transmission coefficients for light of mean refrangibility show that for one centimeter the loss by obstruction amounts to 2·02 per cent. with crown glass and 1·15 with flint glass." The refractive index of lighthouse glass lying between 1·52 and 1·54, the loss may thus be practically taken as 2½ per cent. for ten millimeters of thickness.

The intensities of lighthouse apparatus have of late been diligently considered by lighthouse authorities with the view of determining once for all the relative values of the six orders of lights, and of the lamps appropriate to them, and also of publishing the results in the Admiralty Light list. A large amount of uncertainty and misconception seems to have prevailed on this question. M. Allard, in 1876, in a celebrated memoir, gave an elaborate exposition of the whole subject, but his conclusions, always tending to excess, have not been accepted by more recent investigators.

Other estimates, official as well as private, and more or less discordant, have from time to time appeared, both in this country and France. The factors of evaluation, such as radius, lens surface, vertical section, flame, reduction for losses, etc., have been combined in different ways by different persons, and some of their conclusions must be regarded as merely empirical. But in 1891 and 1892 a serious attempt was made by a committee of the chief engineers of the three lighthouse boards to compile an accurate schedule of intensities with photometry as a basis. Taken as a whole, the values arrived at are fairly acceptable, not certainly erring on the side of excess.

But as yet only the lights with oil or gas for illuminants have been determined.

Electricity appears even more difficult to deal with, and no intensities have been assigned officially to any of the electric lights in the British Islands.

Thus it is uncertain whether, for instance, we are to consider the Isle of May as of six millions of candles or of twenty-six millions, both estimates resting on competent professional authority. The lights on the feu éclair system, oil and electric, are obviously less amenable still to formulæ which may give their coefficients of intensity, although French writers do not hesitate to define these, and deduce thirty or forty millions of candles as "ayant la consécration de la pratique."

It is much to be desired that as a sort of sequel to the publication of the intensities of lights—at all events, of the British lights—there should be provided a form for every vessel under the control of the Board of Trade, in which a return should be made of the appearance of every light approached or passed, with statement of the weather, distance, name and character of the light, etc. These returns, duly kept and handed to the Board of Trade on the first opportunity, would gradually constitute an invaluable record of the merits or demerits of our lights, instructive to the engineer, and through him beneficial to the mariner. I have repeatedly, but in vain, urged this expedient on the authorities.

The administration of lighthouses in this country has undergone no change in the past decade, nor, indeed, since 1861, when the royal commission on lights recommended that a central board should be constituted instead of the quadriform government then, as now, in force, and gave excellent reasons for the recommendation. The further experience of thirty-six years has amply confirmed the earlier conclusions on this subject and has brought into stronger relief the example of the French administration. Some slight approach to the desired reconstruction may be indicated in the report of the committee of inquiry on the mercantile marine fund of 1896, paragraph 71, in the following words: "From the evidence brought before us, we unanimously recommend the formation of a small committee containing representatives possessing as far as possible nautical knowledge, of the Trinity House, the Scotch Board and the Irish Board, which should be summoned at least once a year to advise the Board of Trade upon the desirability of all new works, whether in respect of lighthouses, steamers, buoys or signals, together with all renewals, alterations and important repairs."

But however we may regard the system of government of our lighthouses in contrast with the French system, and desire its amelioration, it is impossible to deny that the United Kingdom has, during the Victorian era, produced men who individually have done fully as much in every part, theoretical and practical, of lighthouse science as have the distinguished men of the sister country. In one group we can point to the names of Faraday, Airy, Thomson and Chance. In another to those of Stevenson, Douglass, Hopkinson and Matthews. In yet another to those of Farrar, Nisbet, Sydney, Webb, Trevor, Wharton and Nares.

These men have enriched and illustrated lighthouse mathematics, engineering, optics, mechanics and nautical and general administration in a manner and with a success to be gratefully remembered in our day and never to be forgotten in the new developments of the years to come.—J. Kenward, in Nature.

INTERDEPENDENCY OF INVENTIONS.

THE advent of important and valuable inventions is often dependent, not upon the brilliant inspiration of some individual inventor, but upon the general and gradual advance of the state of the art to which they belong, making their occurrence not only possible, but almost inevitable. The bicycle is an excellent example of this kind of growth in mechanical construction, since, while it is one of the most important things both mechanically and commercially which has ever been producted, it owes its development to the parallel improvement in metal and rubber working, without which it could never have existed at all, in the modern sense, or to any extent. The clumsy wooden velocipede would always have remained a useless toy had not the introduction of drawn steel tubing made the construction of a light and yet strong frame possible, while the original leather tire of Dunlop could never have led to the practical application of the pneumatic principle without the substitution of the rubber construction which only the advances in rubber manufacture made possible. This is but one instance of what is apparent in many other lines of work, and there is little doubt that if the patent records of the past fifty years were thoroughly studied by competent specialists many inventions, which at the time of their conception were failures simply because of the impossibility of executing the ideas, would now be found both practicable and valuable.—Cassier's Magazine.

Bamboo is used almost exclusively for furniture. It is, however, an excellent material for making scaffolds for building. It decays neither in water nor in the earth, and is rendered harder than ever by dryness. It is also very strong in proportion to weight. Stems 4 inches thick may be used for scaffolds 25 feet high, and will bear the weight of iron beams weighing twenty hundredweight. The length of the stems, too, is a great advantage; some of them grow over 65 feet high.—Wiener Gewerbe Zeitung.

ENGINEERING NOTES.

Seven of its small and obsolete steamers have been sold by the Norddeutscher Lloyd to another Bremen steamship company for a million and a quarter marks. This sum means over thirty dollars a ton, a high price for old steamships.

It is reported that in the year 1896-97 there were seven accidents on Indian railways for every 100,000 train miles run, the number being the same as in the previous year. The proportion of passengers killed, however, was considerably greater, being one in 9½ millions, as against one in 19 millions.

On the London and Northwestern Railway alone there are 17,000 signals lighted every night, says The Engineer, and an engine driver working from Crewe to London and back for his day's work is controlled by no less than 570 signals, to say nothing of those coming under his observation which do not affect the working of his train.

The deepest pit in the world is that at Pernschowitz (Silesia, Germany), which has a depth of over 6,500 ft. below the surface. It has been found by experiment that the temperature in this pit rises by 1° Centigrade for every 143 ft., being 12° at the top and 63° at the bottom. This result agrees with those obtained in similar cases.—La Science en Famille.

Compressed air is now being used by certain American tool makers for performing the feeding, etc., of automatic machine tools, says Engineering. In a screwing machine made by the Acme Machinery Company, of Cleveland, O., the whole of the tools are thus effected. The attendant has only to place the blanks in position, when the machine does all the rest. Very rapid work is thus accomplished, some 7,300 ⅝ in. bolts being threaded in nine hours with a machine having two screwing heads. The same agent is used by another American firm for operating the feed motions and reversing gear of large planing machines. Shifting belts are thus avoided, with the constant wear and tear.

In regard to riveting with compressed air, the master mechanic of the Santa Fé road is quoted as saying that by the use in the Santa Fé shops of a stationary riveting machine three men are enabled to drive 2,000 rivets per day of ten hours at a cost of $4.75, as compared with 200 rivets per day at a cost of $5 by hand labor; the truck riveters—the machine being operated by two laborers at a total cost of $3 per day—drive 3,000 rivets, as compared with 175 rivets driven by hand labor by three men in a day at a cost of $6, while the staybolt breaker makes an average saving of $8 a day and the tank riveter an average daily saving of $10. Further, the mud ring riveters will drive as many rivets as can be handed to them and will make a saving of $12 to $15 a day for that class of work. Not only is this method credited with the great saving named, but it is declared to insure every rivet hole being filled entirely and insures tight work, while of hand-driven rivets in mud rings a large percentage invariably leak.

In using a graphite crucible the first step is the annealing. When the crucible comes from the kiln, where the temperature is very high, it is supposably "bone dry." It is, however, porous, and easily absorbs moisture; hence it should always be stored in a "bone dry" place. As to annealing, both too little and too much stress can be laid on it. The best annealing is even heating. That is, evenly warm the pot, not on one side only but around the pot, to between 250° F. and 300° F., and maintain that heat there until all moisture is expelled. Nothing more is required, except equally good attention should be given to the even cooling all around the pot. The pith of annealing, according to a correspondent of The Engineer (New York), is that the crucible should be heated and cooled off evenly, and receive heat enough and no more than enough to expel its accidental moisture. If the crucible is a large one, after toasting its outside walls, set it over a black, low, slow fire, bottom side up, so that the inside walls, as well as the outside, can get the benefit of the toasting process.

According to a return just issued in the form of a blue book, more than 99 per cent. of the engines and carriages belonging to the different railway companies of the United Kingdom are fitted with a continuous brake, the brakes being not only continuous but also automatic, and constructed in compliance with all the official conditions, says The Engineer. Less than eight years ago more than 10,000 railway vehicles were fitted with brakes which satisfied only some of the demands made by the department, whereas the number has now shrunk to a little more than 20. After allowing for less than 500 vehicles having no continuous brake, perfect or imperfect, we come to a grand total of more than 65,000 carriages and 12,000 engines fitted in the manner prescribed. The extent to which the approved brakes are employed is shown in an interesting form by a statement as to the number of miles run by trains so equipped. In the last six months of 1896 the miles traversed exceeded 100,000,000, being more than 99 per cent. of the total. The Great Western and Northwestern trains each run more than 11,000,000 miles under such conditions.

The Norfolk and Western Railway has equipped its baggage cars with an arrangement of safety bars and hooks for supporting bicycles at the top of the car out of the way of other baggage. Wrought iron holders covered with rubber hose are fastened by screws to blocks placed between the car lines in the center of the roof. These holders are spaced in pairs 3 ft. 8 in. apart throughout. Straps are fastened to either side of the car, central with each pair of bicycle holders, and safety bars are placed across the top of the car between each set of holders and straps. In loading bicycles they are inverted, and the holders in the center of the car roof are hooked into the rims of the two wheels. The frame of the bicycle is then tilted up toward the side decks, the strap being wrapped a few times around the frame, after which its end is slipped over the hook, thus holding the wheel in place. A small stool is carried in each baggage car, by the use of which the straps are easily reached. There is provision in the long baggage cars for carrying 16 bicycles, in the short baggage cars for 12, and in the combination baggage and passenger cars for 8 bicycles.

ELECTRICAL NOTES.

England is secretly laying a military cable between Vigo Bay and Gibraltar, according to the Paris Matin.

After considerable deliberation, the tramway company of Boulogne-sur-Mer (France) has decided on the adoption of the trolley system with overhead conductors.—L'Industrie Electrique.

At Santiago (Chile) a great enterprise is planned. By utilization of the force of a waterfall the whole town is to be supplied with electric light, and the tramway system is to be installed after the present means of locomotion are discarded.—L'Industrie Electrique.

A prominent water wheel manufacturer in San Francisco, according to the Electrician, has recently contracted with a Kobe firm to supply three 500 horse power Pelton impulse water wheels, to be operated under a head of 200 feet. The water wheels will be direct connected to General Electric generators, which will furnish power for an electric railway in Kobe. The contract was secured in the face of severe competition with prominent German and other European firms.

The electric colored fountains at the Brussels Exhibition are now working satisfactorily. The installation is hidden underneath the reservoir, and there are some forty-eight hand projectors used. These throw the light vertically upward through openings which are glassed over. The central space is surrounded by lead pipes, from which 150 jets throw the water to a height of from 7 to 8 yards. These being lit up from underneath by different colors alternately blending, produce an ever varying effect with brightest hues.

Electric Power for Weaving.—At present 1,200 looms at St. Etienne are driven by electrical power, distributed by the company there. The charge is $2 per month, and it is found that hand looms, after conversion to suit them for electrical power, can produce 25 per cent. more work, with a great lightening of labor. The success of this scheme, says The Engineer, suggests the possibility that cheap electrical power in this and other countries may be the means of enabling aged and weak persons to undertake work in their own dwellings.

An electric system of railway signaling, invented by Mr. W. S. Boult, which is now being tested in daily working on the Manchester, Sheffield and Lincolnshire Railway, near Dinting station, promises to be of great importance. It is, says the Builder, a very simple one. An electro-magnet on the road actuating two needles in a box below the engine, and each of them completing a circuit, works two miniature semaphores in front of the driver, and at the same time rings a bell. The signalman is thus enabled to have direct communication with the driver and guard even when the train is at full speed. If this system stands the test of further experience, it will make semaphores and colored lamps superfluous and do away with the present barbarous system of fog signaling.

At the Société de Biologie, at Paris, Dr. Luys read a paper describing experiments made by him, showing the presence of luminous emanations which surround the human body, and he demonstrated it in the following manner, says the Electrical Engineer: In the dark room, place your fingers for about twenty minutes on an ordinary photographic plate which is itself in a bath containing the usual solution of hydroquinone, and after this exposure fix the negative in the usual way. You will see not only your fingers and the lines on the skin reproduced, but also their pores, and, what is still more interesting, round the fingers a sort of zone or halo a third of an inch wide, which would lead one to believe that we live in a luminous fluid, which has enabled us to obtain a photographic print of itself and of the fingers, as if under the influence of light. Dr. Luys has tried the same experiment, but without any results, on patients whose hands were paralyzed, benumbed or insensible to touch. No image appeared on the plate.

W. Toritch & Co., of New York City, have been advised that an electrical exhibition is being planned by the Russian Electro-Technical Society, to take place in St. Petersburg the early part of 1899. Everything pertaining to electricity will be admitted. This will give an opportunity to introduce in Russia, they say, a number of American manufactured goods in the electrical line which heretofore were unknown in that market. The exhibition buildings will be put up in the center of the city. In the surrounding canals electric yachts will ply. Different systems of electric railroads, suspended as well as on sleepers, will be built, and also electric elevators and moving platforms. Some of the buildings put up at Nijni Novgorod for exhibition purposes will be taken to St. Petersburg. At the close of the exhibition some of the principal exhibits will be retained to form an electrical museum in St. Petersburg. Several millions of rubles, which will be necessary for the expenses of the exhibition, will be furnished by the Russian government, the city of St. Petersburg, and by the Electro-Technical Society of that city.

A new cable recorder, invented by M. Ader, is described in La Nature of July 24. It consists essentially of a fine wire stretched vertically in a magnetic field created by a strong horizontal electro-magnet, the poles of which surround the wire. The currents from the cable traverse the wire, which moves to the right or left—that is, toward the north or the south pole of the electro-magnet—according to their direction. A shadow of the wire is projected across a slit, behind which a band of photographic paper travels. A black spot thus falls upon the paper, and as the wire moves to the right or left the movements are traced upon the photographic paper by the shadow of the spot, the result being a record similar to that given by the siphon recorder. The paper is developed automatically in three baths contained in a small dark chamber, and the signals are shown in white upon a black ground. As to the speed obtained, 350 letters a minute, that is, about seventy words, have been recorded through the cable between Marseilles and Algiers, and 150 letters per minute have been recorded upon the Brest-New York cable, the transmitter being at St. Pierre-Miquelon and the receiver at Brest.

SELECTED FORMULÆ.

Remedy for Ants.—Many ways of getting rid of ants have been suggested, but few work satisfactorily. The following, however, has stood the test very well. Lay on a plate, accessible to the insects, several slices of raw meat, exposing as great a surface as possible. Let these stand for some hours, and you will find them crowded with ants, as they greatly relish raw meat. Now throw the whole into fire or boiling water. Repeat the same process, if necessary, till you are no longer troubled.—Science en Famille.

Plate Backing.—Plate backing to prevent halation may be prepared from:

Paraffine wax	20	parts.
Olive oil	20	"
Light lampblack	10	"

Let these melt in gentle heat and apply with flat brush. Before development remove with a knife.

In case of emergency a piece of gelatino-chloride paper, printed to redness, and washed free of silver may be used for backing a plate.—Revue Scientifique.

Lead Paper.—To prepare a lead printing paper proceed as follows: Lay some coarse drawing paper (such as contains starch) on an 8 per cent. potassium iodide solution. After a moment take it out and dry. Next, in the dark room lay the paper face downward on an 8 per cent. lead nitrate solution. This sensitizes the paper. Again let dry. The paper is now ready for printing. This process should be carried on till all the detail is out in a grayish color. Then develop in a 10 per cent. ammonium chloride solution. The tones obtained are of a fine blue black.—Revue Scientifique.

Protecting Iron from Rust.—Iron may be protected against rust by the use of potassium bichromate. A concentrated solution of this substance is brushed over the metal, which, when dry, is heated for some two minutes in a furnace or over a coal fire. The heat reduces the chromic acid, and produces the result desired. To test whether the heating has been carried far enough, rinse the iron with water; if the water is colored, the article must be further heated. If the heating is carried on to excess, the article is covered with a fine black coat.

Putz Pomade.—Many formulas have been published for the production of "pomades" for cleaning and polishing metal. It is said that the well known article sold as "putz pomade" consists of Armenian bole, made into a paste with oleic acid and nitro-benzol enough to give the mixture an odor. The term "putz," it may be explained, is a German one for "cleaning."

J. W. Colcord has proposed the following formula for a paste of this kind:

Oxalic acid	1	part.
Peroxide of iron (jewelers' rouge)	15	"
Rottenstone	20	"
Palm oil	60	"
Petrolatum	5	"

Pulverize the acid and the rottenstone and mix thoroughly with the rouge. Sift to remove all grit, then make into a paste with the oil and petrolatum. A little nitro-benzol may be added to scent the mixture.—Drug Circular.

Cement for Leather Belting.—The importance of suitable cement for making joints in leather driving belts has led the Society of Chemical Industry to indorse the following formula: First, equal parts of good hide glue and American isinglass, softened in water for ten hours, then boiled with pure tannin until the whole mass is sticky, the surface of the joints to be roughened and the cement applied hot; second, one kilogramme of finely shredded gutta percha digested over a water bath with 10 kilogrammes of benzol until quite dissolved, when two kilogrammes of linseed oil varnish are stirred in; third, one and a half kilogrammes of finely shredded India rubber are completely dissolved in ten kilogrammes of carbon bisulphide by heating, and while hot one kilogramme of shellac and one of turpentine are added, and the solution heated until the two latter ingredients are also dissolved; fourth, one kilogramme of the best glue is dissolved at a moderate heat in one and a half kilogrammes of water, and thickened to the consistency of sirup. One hundred kilogrammes of thick turpentine and five grains of carbolic acid are carefully stirred in while hot; the mixture to be poured into flat tin pans and allowed to cool, then cut into pieces and dried in the air. The cement is made liquid with a little vinegar and applied to the joint with a brush; this being done, the two ends of the joint are properly placed together and thoroughly pressed between two iron plates heated to a temperature of about 86 deg. Fah.—Exchange.

Mountant for Photographs.—

Gelatine	16	parts.
Glycerine	1	"
Water	32	"
Methylated spirits	12	"

Let the gelatine soak in water till it is well swollen, then dissolve by the application of gentle heat, and, stirring vigorously, pour in the alcohol in a thin stream. Use warm.—Cosmos.

Bronze for Copper.—Dissolve in 200 parts of water:

Copper subacetate	25	parts.
Copper carbonate	25	"
Ammonium chlorhydrate	45	"
Acetic acid	10	"

In this solution boil the article to be bronzed. Use copper vessel (not tinned).—Cosmos.

Remedy for Insomnia.—A simple and harmless remedy against nervous insomnia consists in laying a moist cloth on the neck.—Der Stein der Weisen.

Ashes for Lawns.—Ashes strewn on lawns prevent the growth of moss and promote that of the grass. Soot, which is often thrown away, is an excellent fertilizer, particularly for grass, onions, potatoes, and all kinds of radishes. Both ashes and soot have the property of keeping away sand fleas and little snails. An excellent fertilizer is obtained by mixing nine parts of soot with one of salt.—Der Stein der Weisen.

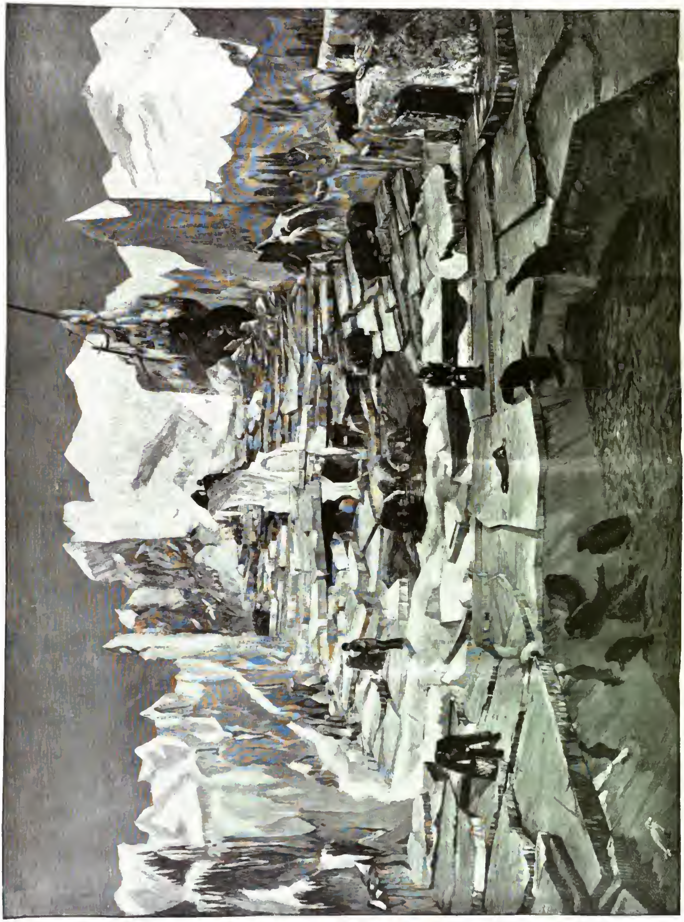
HAGENBECK'S PANORAMA OF A NORTHERN SEA.

THE vivid interest in the regions far north, which was so remarkable in days gone by, has recently been stirred anew by the successful efforts of Nansen and Andrée's daring enterprise. In anxious suspense the whole world awaits the time when news from the aeronaut will be received, and our imagination figures up before our eyes a picture of desolate, snow-covered plains, beset with huge and shapeless blocks of ice, and animated with fearful polar bears and inoffensive seals, a scene from the land where so many explorers have succumbed in battle with a great and dreadful foe.

But a more concrete representation than these fancies of our minds has been set before the interested European. Transplanted, as if by a magician's wand, from regions of perpetual snow into our temperate zone, a scene of Arctic life is laid amid the busy life of the great Hanseatic town of Hamburg.

Charles Hagenbeck, the well known dealer in wild animals, has, by the aid of painter and sculptor, constructed an artistic panorama of a northern sea, and has added a novel charm to it by animating the scene with live beasts.

On entering the panorama the visitor is ushered into an ice grotto, from which he looks on the Arctic landscape. On his right and left great icebergs of extravagant shape rise from the ground. Their forms bound the horizon on either side. In the foreground the sea is covered with blocks of ice, which, in some places, have glided on one another, forming heaps, and in one



PANORAMA OF ARCTIC LIFE AND SCENERY.

spot have left an opening where the seals, cormorants and sea gulls are able to enjoy a fresh bath. In the rear the floating ice has been crushed together more strongly, towering up high, and holding up an ice-covered ship. The background is formed by the ice and snow covered coast of an Arctic island.

Quite a number of bears—about a dozen—are free in this panorama. Apparently there is no barrier separating them from the lookers-on. No grating divides their domain from us, so that we imagine that they might, if they pleased, pay us an unwelcome visit. But our safety has been sufficiently provided for. The bears are inclosed in a large den, the sides of which are found in the iceberg walls of the panorama, while the front is secured, unlike the front of the dens in the zoological gardens, by a deep, dry ditch, with smooth sides, which stretches across the landscape, dividing foreground from background. This ditch is hidden from the view of the visitors by a clever arrangement of the scenery, and is so made that no bear would attempt to slide down one wall and climb up the other.

With perfect composure we may, then, stay to watch the feeding of the animal inhabitants. An Eskimo, clothed in sealskin, appears in the foreground. As soon as the seals notice that he is carrying fishes, they raise their hoarse barking voices, sea gulls and cormorants join with their croaking cries; everything comes into motion. All sorts of salt water fish are distributed as food—herrings, shellfish and others.

Birds and mammals alike have a healthy appetite. Not only do the seals swallow their food whole, but the sea gulls, too, take very large bites; and even the cormorants swallow whole shellfish without much ado.

Then the polar bears, too, are visited by an Eskimo. With a great whip he drives the great beasts before him like a herd of sheep. One bear, who turns back, he pats on the head, another he strokes on the back. Evidently, he is not afraid of the bears, and they are not afraid of him. They take their food from his hand and catch in their mouths the pieces thrown to them. They are splendidly trained, and obey their keeper on a word or even a sign—a fact which surprises us when we think of the vicious character of this particular species of bears.

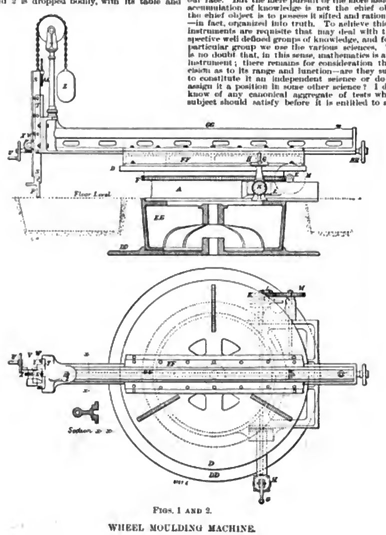
In the evening the sea is brilliantly illuminated by concealed electric arc lamps, while the icebergs in the back are set aglow by an imitation of polar light.

Last summer this panorama formed one of the attractions of the Berlin Exhibition. At the present time it is on view at Hamburg, as we mentioned above.

Our illustration is from Illustrite Zeitung.

MACHINE MOULDED WHEELS.

THE accompanying illustrations are those of the machines of Messrs. Buckley & Taylor, of Oldham. D D is a plate permanently sunk in the floor. E E is a foundation ring or pan which fits within, and which is tapered to facilitate its removal when the floor happens to be wanted for other work. Into E E the base A in Figs. 1 and 2 is dropped bodily, with its table and



FIGS. 1 AND 2.

WHEEL MOULDING MACHINE.

wormwheel, fitting by means of a central pin into the boss in E E.

Upon the table is bolted the seating and guide, with loose strips, in which the radial arm, G G, is slid by means of a screw and handwheel, H H, seen at the right hand. The great length of the slide and of the adjustable strips removes all objections on the score of tipping, which becomes a source of serious trouble when moulding wheels of large diameter. The mechanism for the vertical movement of the block can be a permanent fixture on the end of the arm, or it can be detached from the jib of the table machine and bolted to the radial arm.—Engineering.

THE BRITISH ASSOCIATION—ADDRESS IN MATHEMATICS AND PHYSICS.

THE address in Section A was delivered by Prof. A. R. Forsyth, M.A., D.Sc., F.R.S., who, in the course of his remarks, referred to the relations which pure mathematics have with other branches of science, and appealed for more attention to be paid to them. It is not enough for my purpose, he said, to be told that the British Association includes all science in its scope, and consequently includes pure mathematics. A statement thus made might be framed in a spirit of mere sufferance; what I wish to secure is a recognition of the subject as one which, being full of life and overflowing with a power of growth, is worthy of the most absorbing devotion.

It will readily be conceded for the present purpose that knowledge is good in and by itself, and that the pursuit of pure knowledge is an occupation worthy of the greatest efforts which the human intellect can make. A refusal to concede so much would, in effect, be a condemnation of one of the cherished ideals of our race. But the mere pursuit or the more assiduous accumulation of knowledge is not the chief object; the chief object is to possess it sifted and rationalized—in fact, organized into truth. To achieve this end, instruments are requisite that may deal with the respective well defined groups of knowledge, and for one particular group we use the various sciences. There is no doubt that, in this sense, mathematics is a great instrument; there remains for consideration the decision as to its range and function—are they such as to constitute it an independent science or do they assign it a position in some other science? I do not know of any canonical aggregate of tests which a subject should satisfy before it is entitled to a separate establishment; but in the absence of a recognized aggregate, some important tests can be assigned which are necessary, and may, perhaps, be sufficient. A subject must be concerned with a range of ideas forming a class distinct from all other classes; it must deal with them in such a way that new ideas of the same kind can be associated and assimilated; and it

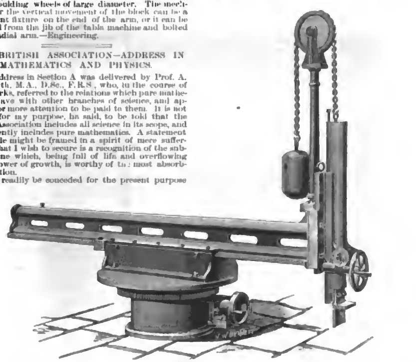


FIG. 3.

should derive a growing vigor from a growing increase of its range.

For its progress, it must possess methods as varied as its range, acquiring and constructing new processes in its growth; and new methods on any grand scale should supersede the older ones, so that increase of ideas and introduction of new principles should lead both to simplification and to increase of working power within the subject. As a sign of its vitality, it must ever be adding to knowledge and producing new results, even though within its own range it propound some questions that have no answer and other questions that for a time defy solution; and results already achieved should be an intrinsic stimulus to further development in the extension of knowledge. Lastly, at least among this list, let me quote Sylvester's words: "It must unceasingly call forth the faculties of observation and comparison; one of its principal methods must be induction; it must have frequent recourse to experimental trial and verification, and it must afford a boundless scope for the highest efforts of imagination and invention." I do not add as a test that it must immediately be capable of practical application to something outside of its own range, though of course its processes may be also transferable to other subjects, or, in part, derivable from them. All these tests are satisfied by pure mathematics; it can be claimed without hesitation or exaggeration that they are satisfied with ample generosity. A complete proof of this declaration would force me to trespass long upon your time, and so I propose to illustrate it by references to only two or three branches. First, I would refer to the general theory of invariants and covariants. The fundamental object of that theory is the investigation and the classification of all dependent functions which conserve their form unaltered in spite of certain general transformations effected in the functions upon which they depend.

Originally it began as the observation of a mere analytical property of a particular expression, interesting enough in itself, but absolutely isolated. This then suggested the inverse question: What is the general law of existence of such functions if they exist as more than mere casual and isolated occurrences? and how can they all be determined? The answer to these questions led to the construction of the algebraical theory of invariants for linear transformations, and subsequently to the establishment of covariantive forms in all their classes. Next came the question of determining what is practically the range of their existence—that is, is there a complete finite system of such functions in each particular case? and, if there is, how is it composed, when in a form that ought to admit of no further reduction? These questions, indeed, are not yet fully answered. While all this development of the theory of invariants was made upon these lines, without thought of application to other subjects, it was soon clear that it would modify them greatly. It has invaded the domain of geometry, and has almost recreated the analytical theory; but it has done more than this, for the investigations of Cayley have required a full reconsideration of the very foundations of geometry.

It has exercised a profound influence upon the theory of algebraical equations; it has made its way into the theory of differential equations; and the generalization of its ideas is opening out new regions of the most advanced and profound functional analysis. And so far from its course being completed, its questions fully answered, or its interest extinct, there is no reason to suppose that a term can be assigned to its growth and its influence.

As one reference has already been made to the theory

of functions of a complex variable, in regard to some of the ways in which it is providing new methods in applied mathematics, I shall deal with it quite briefly now. The theory was, in effect, founded by Cauchy; but, outside his own investigations, it at first made slow and hesitating progress. At the present day, its fundamental ideas may be said almost to govern most departments of the analysis of continuous quantity. On many of them it has shed a completely new light; it has educed relations between them before unknown. It may be doubted whether any subject is at the present day so richly endowed with variety of method and fertility of resource; its activity is prodigious, and no less remarkable than its activity is its freshness. All this development and increase of knowledge are due to the fact that we face at once the difficulty which even the schoolboy meets in dealing with quadratic equations, when he obtains "impossible" roots; instead of taking the wily x as our subject of operation, we take the still wilier $x + y \sqrt{-1}$ for that purpose, and the result is a transfiguration of analysis. In passing, let me mention one other contribution which this theory has made to knowledge lying somewhat outside our track.

During the rigorous revision to which the foundations of the theory have been subjected in its reestablishment by Weierstrass, new ideas as regards number and continuity have been introduced. With him, and with others influenced by him, there has thence sprung a new theory of higher arithmetic; and with its growth, much has concurrently been effected in the elucidation of the general notions of number and quantity. I have already pointed out that the foundations of geometry have had to be reconsidered on account of results finding their origin in the theory of invariants and covariants. It thus appears to be the fact that, as with Plato, or Descartes, or Leibnitz, or Kant, the activity of pure mathematics is again lending some assistance to the better comprehension of those notions of time, space, number, quantity, which underlie a philosophical conception of the universe. The theory of groups furnishes another illustration in the same direction. It was begun as a theory to develop the general laws that govern operations of substitution and transformation of elements in expressions that involve a number of quantities; it soon revolutionized the theory of equations. Wider ideas successfully introduced have led to successive extensions of the original foundation, and now it deals with groups of operations of all kinds, finite and infinite, discrete and continuous, with far reaching and fruitful applications over practically the whole of our domain. So one subject after another might be considered, all leading to the same conclusion.

I might cite the theory of numbers, which has attracted so many of the keenest intellects among men, and has grown to be one of the most beautiful and wonderful theories among the many in the wide range of pure mathematics; or, without entering upon the question whether geometry is a pure or an applied science, I might review its growth alike in its projective, its descriptive, its analytical, and its numerative divisions, or I might trace the influence of the idea of continuity in binding together subjects so diverse as arithmetic, geometry, and functionality. What has been said already may, however, suffice to give some slight indication of the vast and ever widening extent of pure mathematics. No less than in any other science, knowledge gathers force as it grows, and each new step once attained becomes the starting point for steady advance in further exploration. Mathematics is one of the oldest of the sciences; it is also one of the most active, for its strength is the vigor of perpetual youth.

CUINAT'S ACETYLENE GAS GENERATOR.

In the acetylene gas generators in which the water falls upon the calcium carbide there are several serious difficulties to be avoided, the greatest of which is overproduction. When the carbide is fresh, the disengagement of the gas is proportional to the quantity of water introduced, but, inasmuch as the liquid first saturates the lime that envelops the carbide before coming into contact with the latter, the proportion of the discharge is no longer theoretical. At the stoppage of the flow, the excess of water thus introduced causes the subsequent decomposition of the carbide, since, in cooling, the lime liberates a portion of the water that it has absorbed. It is therefore either necessary to arrest the normal operation of the generator before suspending that of the consumption apparatus or to allow the gas produced in excess to escape into the air with every precaution possible. There is to be feared, too, an elevation of the temperature resulting from the reaction of small quantities of water in a relatively large mass of carbide.

An endeavor has been made to overcome such difficulties in many ways. Certain inventors throw the carbide into the water, while others introduce it at the bottom of the carbide receptacle, where it progressively ascends.

It is to this category that belongs the generator devised by Mr. Cuinat, and represented herewith. Its arrangements are such that the production of acetylene is absolutely independent of the greater or less regularity with which the friable mass of the residue settles. Were it otherwise, the level of the water might undergo abrupt changes capable of causing an irregular production of gas.

Two distinct receptacles contain the water and the carbide. According to the size of the apparatus, the water reservoir either surmounts the gasometer (Fig. 1) or the carbide receptacle, with which it in both cases is connected by a conduit provided with an ordinary cock at the top and an automatic one at the bottom.

The carbide of calcium is not stored up in a mass, but is distributed in layers of slight thickness. Each of these latter is contained in a circular basket consisting of a solid iron plate disk riveted to a ring about 22 mm. in height, the periphery of which is provided with numerous apertures. These baskets are superposed in their common receptacle, which is capable of holding twenty of them connected in groups of four by means of a couple of pins. These baskets are of variable dimensions, which are so determined that the carbide of each of them shall disengage a volume of acetylene just sufficient to fill the holder of the gasometer. In the type capable of supplying 48 burners consuming 30 liters an hour for five hours, each contains 750 grammes of carbide. After they have been charged, they are piled up in the generator, which is then closed by means of a cover held either by a bridge and bolt (Fig. 1) or by a series of thumb nuts that can be rapidly manœuvred (Figs. 2 and 3).

From the top of this receptacle starts a large conduit that connects with a tubulure fixed to the bottom

FIG. 1.—CUINAT'S ACETYLENE GAS GENERATOR.

of the tank of the gasometer and prolonged by an ascending conduit whose upper part is curved so as to plunge to a slight depth into the water of the tank.

When the apparatus is set in operation, the holder of the generator occupies its lowest position. A tappet fixed to its dome then rests upon the jointed lever of the automatic cock established at the foot of the water pipe and holds it open. As soon as the upper cock is opened the apparatus begins to work.

The water entering the carbide receptacle deluges the contents of the first basket. A chemical reaction at once occurs and the acetylene becomes disengaged and flows to the gasometer, whose holder rises progressively and, at the same time, liberates the lever of the automatic cock, which, under the action of a spring established around the key, gradually closes. The complete shut-off occurs at the moment at which the holder reaches such a position that the subsequent disengagement of acetylene suffices to complete the filling of it at a normal pressure. In this way, there enters each time into the generator properly so called only the quantity of water necessary to cover a single basket, the contents of which correspond to one filling of the holder. All the baskets of the upper rows remain untouched. In truth, the aqueous vapor disengaged is capable of causing a beginning of decomposition of the carbide that it holds in reserve; but the arrangements provided limit the action of this vapor in a large measure. In fact, as the carbide is compressed between solid disks the vapor can hardly come into contact with it except through the apertures in the side of the basket.

Experience has shown that such precautions are very efficacious. In fact, all overproduction and, consequently, all danger of explosion are prevented. We have found on several occasions that gas generators of this system can be arrested in their operation at any moment without giving rise to an appreciable elevation of temperature.

By reason of its avidity for water, calcium carbide constitutes the desiccative par excellence of acetylene; so that the outlet pipe, which is a little above the maximum level that the water in the gasometer tank assumes, ends at a large vertical cylinder filled with carbide that is traversed by the gas before it flows to the apparatus where it is to be used.

In measure as the acetylene disappears from the holder, the latter descends. Its tappet soon meets the lever of the automatic cock and causes it to open progressively. A definite quantity of water enters anew and covers the carbide of the second basket, and the acetylene produced fills the holder again. Upon the gas generator (Fig. 1) there is a water level indicator by means of which the row of the last basket exhausted, and, consequently, the charge of carbide remaining disposable may at once be recognized.

The funnel shaped bottom of this receptacle facilitates the expulsion of the residue through a central mud cock. If one has two sets of baskets at his disposal, the recharging of the gas generator may be done very rapidly.—Revue Industrielle.

DR. MOUNT BLEYER'S TREATMENT FOR CONSUMPTION BY ELECTRICITY.

On the application of the principles underlying these experiments in the sterilization of lung tissue in tuberculosis.

The primary action of the galvanic current—It increases the amount of ozone in the blood, as shown by chemical test of the blood in the arteries—With my theory of animal electricity.*

By J. Mount Bleyer, M.D., F.R.A.M.S., LL.D., New York City.

Schönbein, in drawing his conclusions regarding the nature of ozone, assumed that oxygen was capable of three distinct conditions, viz., ozone electro-negative, antozone electro-positive, and neutral oxygen, which, as its name indicates, had no polar distinction, but could be polarized and depolarized at will.

Of these three so-called forms of oxygen, the investigations of the observers since the day of the great Basle chemist have much changed our views. To-day we admit the existence of only two forms of oxygen—ozone and neutral oxygen; and for the sake of elucidation, I give you the graphic construction of the molecule as I believe it to be:

$$\bar{O} \quad \overset{+}{O} \quad \bar{O} = \text{ozone.}$$

$$\bar{O} \quad \overset{+}{O} = \text{neutral oxygen.}$$

Assuming, as he and the after-coming observers did,

* Read before the Twelfth International Medical Congress, Moscow, Russia, August 19, 1897. By special invitation.

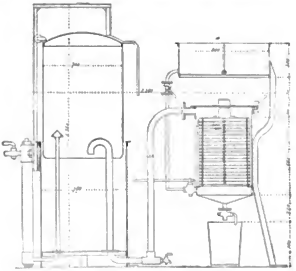


FIG. 2.—VERTICAL SECTION.

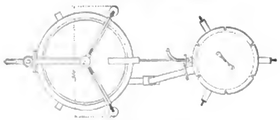


FIG. 3.—PLAN.

that oxygen in its free state was neutral—and it so proved to be—he reasoned—and it is within the pale of all researches, even up to our own time—that as soon, or rather, as I have found it, just before, this oxygen enters into combination with either organic or inorganic substances, in the presence of moisture it becomes polarized.

Carrying these conclusions into the field of physiological chemistry, he became convinced that the corpuscles, like phosphorus, were possessed of the power of polarizing the oxygen in the lungs, and further of splitting up the molecules and rearranging them in the form of ozone. His idea was that ozone existed in the blood, that it was the vital oxidizing agent by means of which the recuperative changes in the tissues were brought about; yet the years of careful work he devoted to searching, failed him in finding the slightest trace of ozone in the blood.

In his later years he became equally emphatic in his assertion that the resolution of ozone, its oxidation, was so rapid that the blood and the moistened tissues surrounding the capillaries, where the real respiration is accomplished, it would be next nigh impossible to chemically detect the presence of ozone by the most delicate test. He even went so far as to doubt its existence in the blood, that is to say, he believed that it was ushered into existence, and was used up in performing its function so quickly that it was not possible to chemically isolate it; that in the blood of the capillaries—presumably the radicals, although he does not so put it—where the pressure conditions are such as to allow of the free interchange of the gases of the blood with the tissue elements, ozone no longer existed.

Like many other great minds, Schönbein was right in many of his claims, but in many other of his theories he allowed himself to fall into error; for, in justice to those who came after him, to study this question of the physiological significance of ozone, and with no discredit to his greatness, Schönbein left much to be cleared up and explained. The ever changing and improving chemical facilities and knowledge made this task far more easy. With the advantages afforded by the chemistry of his day, Schönbein accomplished an herculean task. That famous physiologist, His, who had grown up in the shadows of Schönbein's laboratory and influence, also failed to discover the existence of ozone in the blood.

At the very time His was engaged in his futile efforts, Alexander Schmitt was at work upon the same question—ozone in the blood.

I need not rehearse the details of Schmitt's methods. Suffice it to say his experiments were elaborate and carefully made, and showed beyond doubt that ozone existed in the blood, but the quantity apparently was very small.

Not long afterward, Kühne, improving on Schmitt's tests, proved that ozone existed in the blood in readily appreciable quantity, and the question was forever settled in the affirmative.*

Kühne concluded, and his deductions were not far from approximating the truth, that the red corpuscles greedily absorb ozone under the natural formation of carbonic acid and decompose water as free oxygen is liberated.

Any experiments on the blood with the galvanic current are in a line with those of Kühne and Schmitt, only a short step in advance of those observers, a mere completion of their unfinished tasks. Whatever value the results I have obtained may have, there can be no doubt that the galvanic current applied to the living body, whatever else its action may be, increases the amount of ozone both in the corpuscle and the plasma.

Before entering into a rehearsal of the details of my experiments, let me briefly touch upon the physiology of the blood, the function of its gases, for here it was that I suspected the seat of first physiological action of the galvanic current, and here, too, I was led to trace to its source animal electricity, and observe its function, as I suppose it, in the human economy.

THE BLOOD—ITS GASES AND SOLIDS.

The gases in the blood, the carbonic acid, the nitrogen and the oxygen, which interests us in particular, need not be gone into at length.

The oxygen in the blood exists in two forms—first, that which is held in solution by the plasma, and second, that which enters into combination with the constituent elements of the corpuscle.

The first variety commands our attention for the reason that to all appearances the galvanic current first acts upon this freely dissolved oxygen, and which naturally, therefore, first undergoes the transforming change from O_2 into O_3.

With a single exception, that of defibrinated blood, the blood obeys Dalton's well known law of the absorption of gases by liquids. In vacuum 100 volumes of blood give up a trifle over 73 volumes of gas, of which in arterial blood 20 volumes upon analysis consist of oxygen, while in venous blood the volumes are reduced to between 8 and 10.

The plasma simply holds the oxygen in solution, while the hemoglobin, which by actual weight makes up 90 per cent. of the dried corpuscle, enters into partial combination with the oxygen, although I have observed, and the observations are in keeping with those of other observers, that the oxygen in the hemoglobin is in such a loosely combined state that it readily solves its bonds of union, and under the slightest provocation goes over to the other elements for which it has affinity as soon as the pressure conditions of the plasma are changed so as to permit of a loosening of its bonds.

Plasma, or to be more accurate, fresh serum will upon exposure to the air absorb no more gas than ordinary water under similar conditions, some three volumes; defibrinated or whipped blood, however, contrary to what might be expected, takes up considerably more. This will suffice for the behavior of the gases of the blood; now a word about its solid constituents.

In general, in the plasma there are serum, albumen, globulin and crystallizable, fatty and nitrogenous matter, which, as I shall endeavor to show, are rendered more diffusible by this very transformation of oxygen into ozone, either caused by the polarizing action of the existing animal electricity of the body, or may be rendered more so by the action of the galvanic current.

In the larger vessels, for example, the carotid artery, which I have chosen as the seat of my experimentation, not only because it is accessible and convenient, but rather because it is a direct branch of the aorta, where both the plasma and corpuscles are equipped with all the oxygen they can carry, the blood is charged to its full capacity with these elements, which it is commissioned to give up to, and upon which the tissues depend, particularly oxygen.

All physiologists agree that in these large vessels carrying arterial blood the hemoglobin in the corpuscle is in the form of oxyhemoglobin, which signifies simply that the hemoglobin has entered into partial combination with as much oxygen as it can hold, and that it is ready to transfer this oxygen to the tissues as soon as the oxygen of the plasma has become exhausted and the pressure conditions become so reduced as to permit the giving up of the gas.

This occurs in the capillaries. Until these are reached the pressure of the oxygen in the plasma restrains the hemoglobin from giving its oxygen. Here in the liquid moistening the fibrillæ of muscle that surround the terminal capillaries, where the transfer of oxygen in reality begins, the tension of the oxygen is almost nil, since the tissue elements are steadily taking up the gas from the lymph surrounding them, and the plasma continues to give up oxygen through the walls of the capillaries, until the tension falls too low for it to longer do so; then it is that a portion of the oxygen of the hemoglobin is freed and is dissolved in the plasma to take the place of that oxygen which it has given up and which, in turn, has passed out into the lymph on the other side of the capillary wall. This interchange continues until the pressure of the oxygen in the lymph equals that of the oxygen in the plasma, by which time the venous system of capillaries of the return circulation has been reached.

One of the strong indications of the action of the galvanic current on the blood is the probability that it facilitates this transfer of oxygen to the tissues in active form, both chemically and physically. By rearranging the atoms of some of the molecules of oxygen in the plasma the volume of the oxygen held in solution is reduced, and the oxygen of the hemoglobin is at once transferred to the plasma instead of being doled out, as it were, to suit the constantly varying pressure changes that go on as the blood completes its circulatory round. This being the case, the transforming process is undoubtedly ushered into existence through the polarizing property of the animal electricity, of which I shall speak further on.

How far chemical change is brought about upon the diffusible solids of the blood by the generation and presence of such an increased amount of ozone I am unable to make precise answer, and I leave it to the thoughtful investigation of those observers who may take interest in my work and who are blessed with a more acute knowledge of physiological chemistry and a more completely equipped laboratory than it is my good fortune to possess. To my mind there seems little question of the occurrence of just such a change as I have described. My analyses thus far have remained within the sphere of quality; it remains for others to continue in the more exact line of quantity. Reasoning by analogy, the galvanic current acts precisely upon the oxygen in solution in the plasma as it did in the jar filled with it, through which Schönbein passed the current and observed its transformation into ozone.

There is but one possible action of the ozone in the blood. It must hurry on the transfer of the oxygen to the tissues; call into existence the oxidation of those constructive elements which the tissues require for their revivification. Doubtless these changes are more extensive than I have been able to determine exactly.

OTHER FACTORS TO BE CONSIDERED.

The experiments of Gay-Lussac should teach us a valuable physiological lesson. From his laboratory we feel that we can carry them over to that storehouse of chemical energy, the human body, and observe changes corresponding to those he observed in his jars filled with gases possessed of great affinity for each other, which, however, remained quiescent and inactive until he provided them with the stimulus of a galvanic current, which, as it passed through the gases, spurred into action, or awakened, as it were their slumbering affinities, polarized their molecules, and ushered into life the new something, the result of the three great potent factors, polarization, chemical action and affinity. I have tried to impress upon you the importance of these three conditions, for upon them depend all the chemico-physiological changes, in short, all changes that go on within the human body.

I have observed them time and again in the course of my experimenting and have subjected them singly and together to the most rigorous test of verification.

My observations point to the one conclusion, and that is that chemical action, the feeder of life, cannot go on unless there is present an electrical force, an energy that can polarize the molecules of the combining elements, and prepare them for combining action. Affinity, catalysis, the phenomena of contact, in themselves are impotent without that ever preceding factor—molecular polarization.

It is the metabolism, the anabolism, the katabolism, the all, and more were it possible, of that cardinal nourisher of tissues, that feeder of life, the Blood.

Animal electricity and the important part it plays, I will reserve for a later chapter and pass over to general details of my experiments upon the blood of the living animal in its normal state and under the stimulus of the galvanic current.

(To be continued.)

* Kühne and Scholz, Virchow's Archiven, 1865.

THE INFLUENCE OF LIGHT ON THE SKIN.

IN the July number of the British Journal of Dermatology Dr. Robert L. Bowles states that he has for many years been engaged in investigating the effects of sunlight on the human body, and especially the penetrating effects of rays reflected from snow and other surfaces. Professor Roentgen, he says, finds that certain rays generated or excited by electrical action penetrate most of the human tissues and other substances, and are stopped by substances of a different nature. The author, on the other hand, has demonstrated that reflected luminous or photochemical rays also penetrate the human skin into the deeper tissues beneath and produce within them great and important changes. He gives the following summary of facts and conclusions of various phenomena observed by him from time to time:

1. That heat qua heat is not the cause of sunburn.

2. That there is strong reason for believing that sunburn is caused by the violet rays or ultra-violet rays of light reflected from snow, and that it is not necessarily of the same quality as that which is incident.

3. That Captain Abney finds that the violet or ultra violet rays are very strong at high altitudes, and believes that altitude has much to do with sunburn.

4. That altitude alone does not explain sunburn; for one may be unburned on rocks, say at ten thousand feet, and yet become immediately affected on descending to a glacier three or four thousand feet lower.

5. That sunburn and snow blindness arise from similar causes, and that sunstroke and sun fever may be associated with the effects of penetrating light rays.

6. That rays from the electric light produce much the same results as sun rays reflected from snow.

7. That the bronzing of the skin and the browning of the wooden châlets are probably produced by rays reflected from snow.

8. That various pigments, but chiefly those containing red and yellow, stop or alter reflected rays and prevent the physiological and pathological changes usually due to them.

9. That freckles, which are but the milder effects of luminous or chemical rays, stop the penetration of those rays though the skin.

10. That the sometimes very serious inflammatory changes in sunburn and in what Mr. Hutchinson designates "summer eruptions" are due to the penetration of reflected luminous or photo-chemical rays through the skin to the deeper tissues beneath.

11. That photography often demonstrates the existence of freckles and, report says, various eruptions deep in the skin which are perfectly invisible to the naked eye, showing that the luminous or photo-chemical rays are stopped or altered by them, and not reflected back, as no change is produced on the negative—an effect which suggests that these photogenic rays have penetrating powers as yet unknown.

12. That the wood of Swiss châlets is burned perfectly black (carbonized) on its surface by rays reflected from snow, which rays in time penetrate deep into the substance of the wood and change it to a dark-brown color.

13. That the first effect of snow rays on a new châlet is shown by its action on the resin of the wood, which "sweats out" and leads more easily to the charring of the woody fiber itself and the subsequent changes in the deeper parts.

14. That Captain Maude, R.E., has shown from his own personal experiences and from experiments on many friends, that solar rays in India produced sun fever of a very serious kind, which was entirely prevented by the wearing of an orange lining to all his clothes and inside his hat. These experiments demonstrate the penetrating power of light rays through clothes unprotected by color, and their important influence on health. In relation to this, the author has shown that a lady wearing a linen blouse with red and white stripes was strongly marked with red and white stripes on her shoulders, but the red line on her skin corresponded with the white lines of the linen—that is, the red stripes had completely stopped all rays from affecting the skin beneath them.

15. That the author has often shown that rays reflected from certain surfaces—such as water, gold and silver lace, white walls, white veils, certain clouds and mists—act physiologically in a peculiar manner and quite differently to direct light, and that some physical change hitherto unexplained must take place in light during or after reflection.

16. That in relation with the foregoing are those marvelous changes in the vegetable kingdom connected with the formation of chlorophyl and the deposition of starch.

From these and many other observations Dr. Bowles says that he cannot help feeling that Roentgen rays may be modifications only of ordinary light, and that their further elucidation must go hand in hand with a further inquiry into the profound changes caused by reflection to which he has above referred. It need not necessarily be assumed, he thinks, that what we call darkness implies an absence of all the forms of light.

In August, 1896, the author, assisted by Mr. Travers, undertook some experiments to discover the cause of the radiant energy from snow being so much more irritating to the eyes and skin than direct energy from the sun, as follows:

1. To show the relative values of sunlight and snow-light in freeing iodine from its combination with hydrogen.

2. To test the relative effects of sun on xxx Pagel's plates, inclosed in cases made of aluminum and cardboard, in producing pictures like those of Roentgen.

These exposures, says Dr. Bowles, were effected on snow at an elevation of eight thousand and forty feet, near the hut of the Ober Aletch Glacier, on three consecutive days. The weather was bad and uncertain, but there was some sunlight, and some interesting and definite results were obtained.

Bottles containing equivalent proportions of a sulphuric acid solution and potassium iodide were fixed in cases and exposed simultaneously to the sun and snow; some bottles were coated with pigments, others with cloth of various colors, but each case contained also some of the solution in an uncovered bottle as a control experiment.

The results were expressed in iodine equivalents, and they appear, he says, as Mr. Travers expresses it, "to indicate that the actinic value of the reflected light from snow is somewhere about 0·7 to 0·8 of the value of the direct rays of the sun."

The X ray plate exposed to the sun displayed skiagraphs of a piece of tin, whereas on the plate exposed to the snow no change could be detected; but as there are reasons for the possibility of this plate having been spoiled, this experiment was not conclusive. The author quotes Mr. Travers, in his remarks on the experiments, as follows:

"In dealing with the published accounts of the cases of sunburn and dermatitis produced by the so-called X rays, it is not at all certain that the injury done

to the hands and arms of the operators was due to the rays which are capable of penetrating aluminum sheets, etc. We know that the radiations from a Crookes tube include rays which come within the visible portion of the spectrum, and it is to these rays that we may attribute the power of producing sunburn.

"Further, while it takes a very long time to produce sunburn in the neighborhood of a tube which will fog a photographic plate, contained in a dark slide, in a few seconds light reflected from the snow will sunburn in a very short time, but will not fog a plate in a dark slide.

"In a paper which appeared either in the Lancet or British Medical Journal a few weeks ago, it was shown that the effect produced by certain kinds of light—e. g., light from incandescent gas or arc lamps—produced injurious effects. The injury could not be attributed to the presence of a greater intensity of ultra-violet or violet light than was present in sunlight, but was due to the absence of 'red' radiation.

"In the reflected light from snow the heat rays are nearly entirely absent. The violet (chemical) rays would be present with almost the same intensity as in the direct sunlight.

"Considering the lack of evidence in favor of the X rays pure and simple being a cause of dermatitis similar to sunburn, it is worth while reviewing the facts in support of the theory that the true cause is to be found in the violet or chemical rays, or in the increase of intensity of the violet rays with regard to the intensity of the red rays.

"I think that the facts cited in your paper (British Medical Journal, March 7, 1896) furnish sufficient support."

Here, continues the author, from an entirely physical point of view, Mr. Travers, like others, arrives at conclusions similar to his own, namely, that the vital changes on the skin are due to the chemical rays, and apparently to those rays alone, and that the rays issuing from a Crookes tube are not an entirely new form of energy distinct and separate from light, but contain a proportion of luminous and chemical rays, and that light, as such, as well as the divisions into which it can be split up, may penetrate wood, clothing and the human tissues.

Dr. Bowles refers to Dr. Unna, who, in 1885, dealt very fully with the subject of pigmentary changes in the cutis, and suggested that they depended on the effects of the chemical rays, and that curcuma and colors acting on the light rays would prevent changes taking place. He refers also to an excellent paper by a Dr. Hammer of Stuttgart entitled "The Influence of Light on the Skin," in which the author deals with the subject first biologically; for example, the action of light on worms and other sightless creatures influenced by light through the skin. On the physical side he quotes the experiments of Terrier, Malakoff, and Widmark. From the beginning to the end, Dr. Bowles says, he found Dr. Hammer's work entirely corroborative of his own, but thinks that Dr. Hammer is not sufficiently impressed with the important fact that reflected light burns much more rapidly than direct.—New York Medical Journal.

THE ELECTRIC LIGHT IN RHEUMATISM.

Dr. Kozlovski, a St. Petersburg physician, publishes in the Vrach an account of his method of treatment of rheumatism and neuralgia by means of exposure to the electric arc, says the English Electrical Engineer. He was induced to make these observations by the statement of Dr. Ewald, who is medical officer to some large ironworks, that he had noticed that since the introduction of the system of electric welding there had been a notable diminution in the number of cases of rheumatism, neuralgia, migraine, and other nervous diseases among the workmen, which he attributed to the beneficial effect of the electric light. In order to bring this therapeutic agent within the reach of ordinary patients, Dr. Kozlovski has fitted up consulting rooms with a suitable plant for producing the electric arc, which consists of a 6 horse power oil engine, a dynamo, 35 Tudor accumulators, a rheostat, amperemeter, and electric arc lamp with reflector. With these he obtains an E.M.F. of 50 or 60 volts and a current of from 250 to 300 amperes. The patient is placed at a distance of 1½ meters from the light and protected by blue spectacles and also by a screen of cardboard in which an aperture is cut to allow the light to fall on the affected region of the body. To this it is exposed for from three-quarters of a minute to two minutes. At the time the patient feels a slight sensation of heat, though the temperature is never raised more than 4° F. where the light falls on the skin, but nothing more until six or eight hours afterward, when itching and tingling are felt and the skin becomes reddened. Some 48 hours later desquamation occurs, which lasts for two or three days. In the course of three months Dr. Kozlovski has treated 38 patients, varying in age from 13 to 70 years, by the electric light. There were eight cases of sciatica, all of which recovered; four of neuritis (locality not stated), two of which recovered; 18 of chronic rheumatism, 14 of which recovered; and three of lumbago, all of which recovered. In most cases three or four sittings produced an amelioration of the pain. They were continued at intervals of three or four days, according to the amount of cutaneous irritation, but the total number of sittings never exceeded a dozen. This extract we culled from the Lancet, and are glad to note that as the electric welder was developed by exaggerating the faults of a transformer, so the ill effect of the rays from the welder has some compensating good properties. We suppose that shortly the electric lighting station will be dispensing two minute doses of strong arc light to rheumatic consumers.

It appears that the trade of Marseilles has been decreasing for some time past. In 1891 the total import and export business of that large Mediterranean port amounted to 2,045,800,000 francs. In the following year it decreased 198,000,000 francs, and in 1893 the falling off against 1891 was nearly 280,000,000 francs. In 1894 and in 1895 the decrease was rather less marked, but in 1896 it amounted to no less than 282,000,000 francs. The Marseilles trade has accordingly lost, on an average, 250,000,000 to 300,000,000 francs per annum, or one milliard—200,000,000 francs during the six years from 1891 to 1896.

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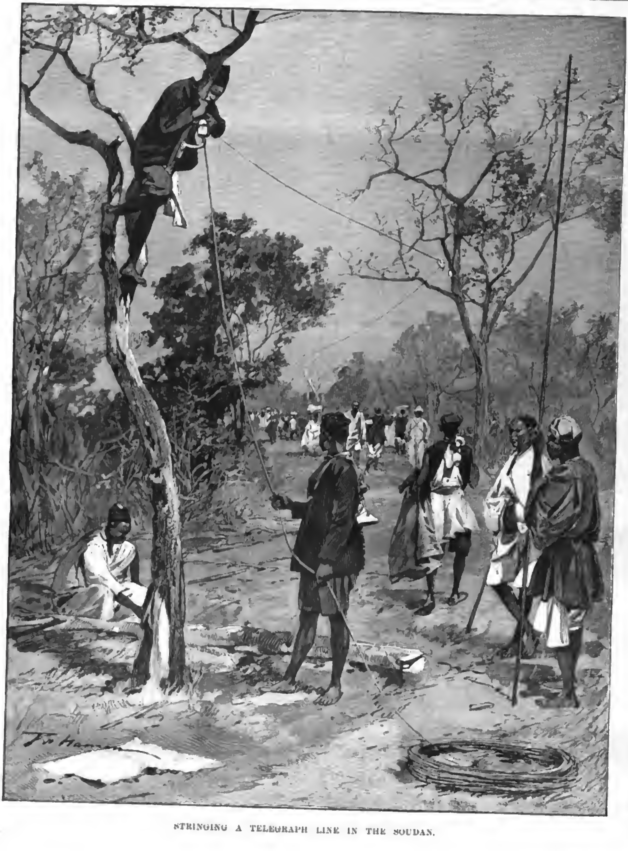


STRINGING A TELEGRAPH LINE IN THE SOUDAN.

THE TELEGRAPHIC SYSTEM OF FRENCH WEST AFRICA.

FOR many years past, public opinion in France has been alive, and very properly, to the ever increasing extension of the English submarine telegraphic system, which, at present, seems like a vast net thrown over the world.

Our own colonies, as well as those of Portugal, Germany, Holland and Spain, correspond with their respective metropolises solely through these English channels, which it would be very easy to interrupt at any moment and for any length of time.

Such enforced tutelage will bear hard upon us as long as private enterprise will not be able to obtain the confidence of the French treasury and to displace the capital still given so foolishly to foreign shadowy corporations.

A slight movement is manifesting itself in this direction. North and Central America, and even Brazil, are communicating with Brest without borrowing British cables, and the new organization will soon receive certain improvements.

A similar work is slowly elaborating on the west coast of Africa. It is certain that the day on which the cable from Saint Louis to Teneriffe is definitely acquired by France, our possessions, which extend from the White Cape to the mouth of the Niger, will have nothing to ask from the companies on the other side of the English Channel.

Without entering into considerations of political order, it is well to set forth the fact that commerce and the administration will not be slow to benefit by the new state of things through the sensible reduction of tariffs. Thus, at present, French Guinea, which was paying the West African Company 5·85 francs per word, is now sending its telegrams at 1·8 francs solely, say a diminution of 4·05 francs. The fact must not be lost sight of that this company receives, in addition, from our government, for each of the offices of Konakry, Grand Bassam, Kotonou and Libreville, an annual subsidy of 75,000 francs. Portuguese Guinea, which probably finds itself in the same situation, is thinking of asking for authority to connect her Boulam, Favim and Jeba counting houses with the telegraph line constructed last year in Casamance, a province of Senegal to the south of the Gambia.

The German and English merchants established upon the Gold Coast, at Togoland and Lagos, who are very practical people, as every one knows, will not themselves hesitate to remit their numerous dispatches to our land lines if the tariff of the submarine lines is not changed. But such fine and desirable results will be attained, and especially preserved, only at the cost of a hearty support on the part of the colonies interested.

Our readers will certainly thank us for adding a few words concerning the progressive formation of this African system, the total length of which will exceed 4,800 miles.

In the first place, and up to a recent date, the different governors who succeeded each other, both in Senegal and the Soudan, merely took into consideration the possibility of giving their administrative orders a quick transmission. In measure with the effective conquest of the country, the lines were elongated. Thus, in 1862, Faidherbe, in order to maintain Cayor, which was continually in commotion, constructed the first line between Dakar and Saint Louis, and, after this, Colonel Pinet Laprorde, along about 1868, undertook to connect with Saint Louis the military posts which were situated along the river and were too distant from headquarters.

It took ten years to force the aborigines, principally the Toucouleurs of Abdul Boubakar, our irreconcilable enemy, to allow telegraph poles to be set up around their villages.

Medina, a station founded in 1855, and which a few years afterward had to sustain a memorable siege against the bands of the prophet El Hadj Oumer, did not, in fact, communicate electrically with Saint Louis until 1885, after the laying of a cable between Barbary Point and Teneriffe.

Our expansion toward the Niger, directed by the successors of Faidherbe, the Borgnis-Desbordes, the Gallienis, and the Archinards, necessitated, as long ago as 1880, the establishment of electric conductors, which now radiate as far as to Segou and Nioro, connect with the Guinea system, and will soon join the lines of Dahomey and the Ivory Coast. This is the object that is now being pursued by Governor-General Chaudie, Colonel de Trentinian, and M. Ballot, governor of Dahomey, where the lines of the coast and those of Abomey, the immediate fruit of General Dodd's campaign, are continued to Carnotville.

Senegal, under the impulsion of its then governor, M. de Lamothe, began in 1893 the doubling of its communications with the Soudan, the correspondence of which was encumbering the sole existing line.

M. Boutrel, director of posts and telegraphs, and M. Magne, subinspector, had charge of this work, which they finished during the first month of last year.

These officials, who have just arrived in France on a sick leave, likewise, in a few months, successfully constructed a line from Konakry to Timbo and the Niger. The cost attending the execution of these vast projects is not so great as one might imagine. On the two last lines, those of Casamance-Boundou and French Guinea, the net cost per mile, inclusive of the purchase of all the exploiting material, did not exceed \$40, while at home work of the same nature costs, upon an average, over \$160.

It would take too long to enumerate the multiple causes of this great difference, but let us say in brief that it is due especially to the ease with which the supply of poles may be obtained right on the spot. Although sand prevails between Dakar and Saint Louis, and although alluviums are found in the deltas and upon the banks of the Senegal, in Saloum and Gambia, ferruginous stones form the elevations and about half the soil in the interior of Senegambia and French Guinea. The excavation of holes of from thirty inches to three feet in depth in this rock requires great effort, since the latter is so compact that it dulls the jumpers. So the wire is frequently strung upon high trees, as shown in our engraving.

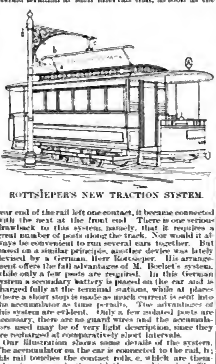
All of the operations connected with the construction of the line are performed by the natives, among whom there are sometimes some superior men, such as the old chief superintendent N'Deue N'Diaye, who, as long ago as 1862, participated in the establishment of the first line in Senegal, and was still traversing the forests of Fouta-Djallon at the head of his men last April. He is an energetic and gentle patriarch whom his men obey with veneration. Of a different character, but possessing remarkable firmness and intelligence, a second chief, Amadou Sar, has the faculty of giving endurance to the laborers, who never tire under his eyes.

Temperaments of this nature know no danger. So they did not flinch when last year the inhabitants of the fortified town of Songkounda, who had promised to arrest the work of construction, refused to give a single bottle of water to the fagged-out gangs, and made the pirogues leave the shore of the Gambia, hoping thus to prevent the crossing of the country.

The recruiting of watchmen for the ulterior maintenance of the lines is effected from among the laborers who have shown aptitude and devotion. Devotion and courage are especially indispensable to men who, often in a foreign country (Senegal alone has up to the present furnished the personnel of this category), have to keep important sections in a proper state in districts that are sometimes mountainous, as Fouta-Djallon, or arid and desert, like Boudou. Under such conditions, white men could not endure the fatigue occasioned by a continual go and come.—L'Illustration.

AN IMPROVED SYSTEM OF OVERHEAD CONNECTION FOR ELECTRIC TRACTION.

THE trolley system with overhead connection has many disadvantages, among which figures chiefly the danger to which the public is exposed in case any of the wire should break. Besides, the system necessitates the use of an unsightly net of suspending and guard wires, which do not by any means add to the appearance of the locality where the cars are run. In spite of these and other faults, the overhead system is still the most frequently used, owing to the high cost of the installation of the underground connections. Recently, however, M. Bochet has brought out an invention which, while avoiding the guard and trolley wires, yet retains all the advantages of the overhead system. He couples two or three cars together and furnishes his train with a conducting rail, which passes certain points of contact with the second terminal in such manner that a constant current is sent through the motors. This result was attained by placing posts connected to the second terminal at such intervals that, as soon as the



ROTTSIEPER'S NEW TRACTION SYSTEM.

rear end of the rail left one contact, it became connected with the next at the front end. There is one serious drawback to this system, namely, that it requires a great number of posts along the track. Nor would it always be convenient to run several cars together. But based on a similar principle, another device was lately devised by a German, Herr Rottsieper. His arrangement offers the full advantages of M. Bochet's system, while only a few posts are required. In this German system a secondary battery is placed on the car and is charged fully at the terminal stations, while at places where a short stop is made as much current is sent into the accumulator as time permits. The advantages of this system are evident. Only a few isolated posts are necessary, there are no guard wires and the accumulators used may be of very light description, since they are recharged at comparatively short intervals.

Our illustration shows some details of the system. The accumulator on the car is connected to the rail, b; this rail touches the contact rolls, c, which are themselves in communication with the second terminal. The cable carrying the current is, of course, underground. At each stop there is a post under which the car is automatically brought into the circuit. The rail, b, is hinged so that it can be flapped down into the position indicated by the dotted lines, b 1. This merely for convenience. Instead of placing the rail on the top of the car, one might also attach one to each side of the car, flapping down the one not in use.

A modification of this system has the rail on the post, instead of on the car. In cases where cars have already been run on the old system, this modification will be made use of with advantage, if the guard wires and the posts are to be discarded, for the old rods by which the current was formerly carried from wire to motor may still be used, so that one change on the car can be dispensed with.

Our engraving is from Uhland's Wochenschrift.

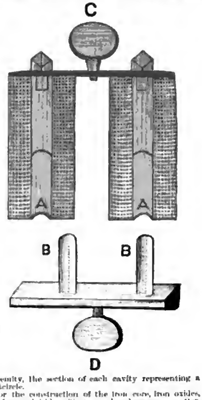
THE ORIGIN OF THE TELEPHONE.

OUR contemporary, L'Electricien, in an article under the above heading, seems to have taken it to heart that no French name has been connected with the invention of the telephone. It has, however, succeeded in satisfying itself that Charles Bourseul nearly invented it in 1854 some seven years before Reis. In an article published in L'Illustration of August 26, 1854, Bourseul raised the question of the possibility of transmitting speech by means of electric currents along a wire. The following passages, which occur in Bourseul's article, certainly show that he started work in the right direction. ". . . Imagine that one speaks near a movable plate which is so flexible that it does not lose any of the vibrations produced by the voice, and that this plate successively makes and breaks connection with a battery. You might have at a distance another plate which would make the same vibrations at the same time. It is true that the intensity of the sounds produced will be variable at the point of departure where the plate is vibrated by the voice, and constant at the point of arrival where it is vibrated by electricity, but it has been shown that this cannot alter the sounds. It is evident, at first sight, that the sounds will be reproduced at the same height in the gamut. The present state of acoustic science does not enable me to say à priori that it would be the same with syllables articulated by the human voice. . . . Any but the deaf and dumb would be able to use this means of transmission, which would require no apparatus of any sort. An electric battery, two vibrating plates, and a metallic wire would suffice. . . . Whatever happens, it is certain that, in the not very far distant future, speech will be transmitted by electricity. I have begun experiments in this direction. They are delicate, and require time and patience, but the approximations I have obtained make me anticipate a favorable result."—The Electrician.

THE SOLENOID ELECTROMAGNET.

By H. N. WARREN, Principal Liverpool Research Laboratory.

THIS powerful type of electromagnets, which, after a lengthy and exhaustive research, has just been perfected at the Research Laboratory, differs from all other magnets in the construction of the iron core; they being intended for either supporting great weights in general or the accommodation of spherical bodies, for which reception a hollow cavity is cut from each



extremity, the section of each cavity representing a semicircle.

For the construction of the iron core, iron oxides, free from sulphides, silicates, and carbonaceous matter, were selected, and reduced in an atmosphere of hydrogen, puddled through a hot blast Siemens furnace, and drawn into bars. The bars are next embedded in quicklime, brought to a full white heat, and allowed to cool in that substance. After cooling, each limb, before yoking, is drilled to within half an inch of its circumference and one quarter of its total length (if the bar be less than half an inch from starting, a corresponding allowance has naturally to be made).

The diagram above illustrates the section of a magnet with its accompanying keeper, the separate parts being further described in the specified table. The magnet was constructed to suspend a weight of ten tons, and required to be excited by a current obtainable from twenty-five boron carbon cells only.

From the above diagram it will be readily observed that when the keeper is applied with its two iron projections, B B, which are constructed of such dimensions as to exactly coincide with the openings, A A, not only is the magnetic power fully utilized, but any side slipping of the keeper is absolutely impossible. All the magnets thus described were wound with No. 14 double cotton covered wire, the winding afterward being covered with paraffined insulation, wound with thread, and varnished with best electro shellac varnish. They are at present doing excellent service in researches on diamagnetism and polarization of light.

The subjoined table will better explain a few of the more important magnets thus constructed, and giving approximate quantities of their component parts:

Length and Diameter of Core.	Weight of Primary.	Voltage Required.	Weight Supported.
2 inches × ¼	4 oz.	6	8 lb.
6 " × ½	1 lb.	10	20 "
28 " × 2	11 "	20	5 cwts.
28 " × 4	100 "	30	2 tons.
28 " × 4½	112 "	30	10 "

—The Chemical News.

NEW DRY DOCK AT HAMBURG.*

The shipbuilding yard and machine shops of Messrs. Blohm & Voss, at Hamburg, which for years have had in operation a large floating dock, known as the "Elb-dock," have just completed a new dry dock, which is the largest of its kind in existence.

This new floating dock has a carrying capacity of 17,500 tons. Its length, with the pontoons, is 624 feet 4 inches and its width 118 feet 1 inch. It is able to raise the largest merchant vessels that have thus far been built, and even the heaviest men-of-war, and consists of seven separate pontoons with high and strong sidepieces. These seven pontoons can be joined together, so as to form one concerted system. Each sidepiece contains an engine and boiler room for the pumps and electric and hydraulic machines. These two machines have condensers and 700 indicated horse power each. They drive fourteen pumps, which are capable of pumping out the dock in forty-five minutes, and thus of raising the largest vessel in this short space of time. In order to regulate the raising and the lowering of the dock, it was necessary to divide each pontoon into several watertight compartments, which are closed by means of stop valves. All these stop valves can be moved from one point by means of hydraulic power, and the depth of water in all compartments is indicated by special apparatus. By this arrangement, it is possible for one person to manage all the stop valves and to direct the pumping.

The blocks upon which the vessel rests are easily movable by machinery from the sidepieces. Altogether, this new dock is supplied with the most modern improvements, some of which were specially constructed. The dock harbor behind the shipyard has a depth of 26 feet 2 inches below 0, so that, at ordinary high tide, vessels drawing as much as 26 feet can be docked. A bridge 118 feet long connects the dock pontoon with the shore, from which the dock is therefore quite accessible. Next to the pontoon and on the quay of the shipyard there is a huge crane, which, when projected 85 feet, can raise 150 tons, and 45 tons when projected 100 feet. By means of this crane, heavy loads can be transferred directly from the shore into the dock across the largest vessels.

Owing to its peculiar construction, this great dock can, in cases of emergency or in time of war, be transferred to Brunsbüttel, at the opening of the Kaiser Wilhelm Canal, to dock vessels which have sustained heavy damages or whose draught is great. As a matter of fact, it is capable of docking vessels with a draught of 29 feet 6½ inches. No vessel with a greater draught than 27½ feet has thus far succeeded in coming up to the port of Hamburg.

Upon applying to the owners of the dock, I was informed that no fixed schedule of charges for the use of the same had been or would likely be determined. It was believed to be more profitable to make special arrangements in each case. I was given to understand that not even the German government had been furnished with any tariff of docking charges, and that for the docking of foreign vessels of war it was probable that there would be charged about $975 for the first day and $250 to $500 for each following day. Messrs. Blohm & Voss desire it to be expressly understood, however, that they do not bind themselves to these figures.

There is little doubt that this capable and energetic firm, by the construction of the new dock, have met a long-felt want in Hamburg, whose docking facilities have of late years by no means kept pace with its shipbuilding. The Hamburg American line especially will have reason to look with favor upon the new enterprise, as it will enable them to dock their express steamers and large freight boats in their home port, instead of having to send them to English or American docks.

The North German Lloyd, of Bremen, which also has some very large boats and is building more, will (as well as the German imperial navy) doubtless be glad to avail itself of these excellent facilities.

Although it is easy for persons connected with shipping to look them up in Lloyd's Register, I deem it not uninteresting to give, by way of comparison, the lengths of the largest graving docks in the world:

Docks.	Length. Feet.
Belfast	825
Birkenhead:	
No. 1	750
No. 2	930
Cardiff	600
Liverpool	768
London (Tilbury)	875
Newcastle (Wallsend)	520
Southampton	750
Antwerp	420
Cherbourg	508
Havre	535
Marseilles	503
Genoa	720
Baltimore (Simpson's)	504
Brooklyn:	
Erie No. 1	630
Erie No. 2	510
Newport News:	
At top	600
At bottom	500
Norfolk, Va	500

It will be noticed that a large proportion of these graving docks are longer than Messrs. Blohm & Voss' new floating dock, which latter, however, far exceeds the dimensions of other floating docks in existence, the length of which is seldom more than 300 to 400 feet. It seems the builders desired a dock which could be transported to almost any part of the river below this port and also one which they considered superior to any graving dock for the safe handling of large and long vessels. W. Henry Robertson, Consul.

Hamburg, April 20, 1897.

Artificial Cider.—The following is a typical formula: 25 gallons (soft) water, 3 lb. tartaric acid, 25 lb. brown sugar, and about 2 pints yeast, are put in a clean cask, and after 24 hours well roused up. Then 3 gallons of spirit are added, the cask bunged, and left for two days. This formula is variously modified, according to taste, by the use of honey, cloves, whisky, etc.

* United States Consular Report.

ARMOR PLATE PRESS.

We illustrate a double hydraulic press, constructed by Messrs. Hayward Tyler & Company, of 90 and 92 Whitecross Street, London, E. C., for bending armor plates. It is designed to work with a pressure of 2,900 lb. per square inch, acting in two inverted cylinders, each of which is provided with a return cylinder for lifting the ram when the pressure is off it. These latter cylinders are provided with screws and handwheels for regulating the height of the lift. The main cylinders have rams of 7¼ in. diameter and 25½ in. stroke, and are 3 ft. 7 in. apart, center to center. The size of the bed plate is 9 ft. 10 in. by 6 ft. 10 in. between the steel tension bars.

The head, bed, caps for the tension bars, main cylinders, and rams, with the return cylinders, are of cast iron. The return rams are mild steel. The rams are packed with U-leathers, and each is fitted with a square iron platen, secured by set screws. There are three hydraulic stop and relief valves, mounted on standards with copper pipes and bends, enabling the cylinders to be worked together or separately.—Engineering.

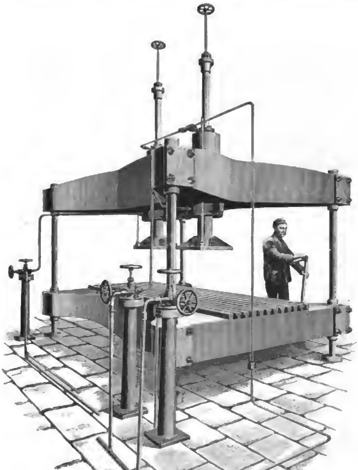
WIND AS AN AID TO FLIGHT.

By F. W. Headley, M.A.

Birds understand wind and all its vagaries, and they turn them all to account. Many problems which men of science are compelled to class among those which they hope to solve some day, or, perhaps, despair of solving, a young bird begins to work out directly he is fledged. I will take some typical cases in which a bird derives help from the wind. It will be found that the wind, if it is to lift a bird, supplementing the work of his wings, or even doing all the lifting, must either move in an upward direction or, if it does not deviate from the horizontal, it must be of unequal velocity. A wind that is unequal, or not uniform, may either be made up of currents moving at unequal rates, or it may blow now gently, now strongly. A uniform horizontal breeze cannot lift or maintain a heavy body in the air unless that body has momentum of its own. It is no better than still air, since the bird—we must try to put ourselves in his position—becomes part of the moving current. The momentum required he derives either from his own wing beats or from the inequalities of the wind. When a bird rises with wings outspread and motionless, there must be inequality, supposing that the wind is horizontal.

A lark, when he is flying upward—always singing in spite of the steepness of the incline, as if to show how easy it is—invariably faces the wind. When he turns away from it he ceases to rise and generally loses elevation. When he wishes again to rise, he turns his head toward the wind. To take another instance: a cormorant, sated at last, wishes to join his comrades who are drying their wings on a rock not far off. The wind is blowing toward the rock in question; accordingly he begins by flying in the opposite direction, so that the wind may assist him as he struggles to rise from the water. This feat accomplished, he turns round and makes all sail for his destination. The lark and the cormorant are quite right in thinking that the wind will help to lift them, but it does so only because it increases in velocity as they rise. Near the surface of the land or the sea it is retarded by friction. An anemometer reveals a very marked increase in velocity at successive elevations not far from the ground.

By means of kites experiments have been made up to a height of a thousand feet, and even there the increase continues, though it is much more gradual. Were it not for this increase of velocity with altitude, the lark, after his first jump from the ground, would, but for his own efforts, move backward with the wind. It would not lift him any more than it will lift a balloon from which the gas has escaped. But perpetually passing from a slower to a more rapid current (in theory it is convenient to divide the air into definite strata), he has always an inertia which enables the wind to lift him. He is still, so to speak, part of the slowly moving stratum below when he emerges into the rapidly moving stratum above. In fact, he illustrates the principle of the kite—inertia, which is equivalent to momentum, taking the place of the string. As long as the kite is held by the string, it will rise; cut the string, and the wind will at once resign it to the mercies of gravitation.



DOUBLE HYDRAULIC PRESS FOR BENDING ARMOR PLATES.

We see then, that if a lark wishes the wind to help him to rise, he must face it—incline his body forward, as a kite is inclined; and, further, that the inequality of the wind must give him inertia or momentum, or else his wings will have to raise him without assistance. When gulls advance at right angles to the wind without any beating of their wings, the principle applied is the same. From some slight elevation they glide downward till they are near the ground or the surface of the sea, then (possibly by a twist at the waist) they turn suddenly and face the wind, which lifts them to their former elevation; after which the process begins again.

It may be that when birds soar, i. e., rise in spirals without moving their wings, they are availing themselves at each upward step of the increasing velocity of the wind. But they sometimes attain an elevation of a mile or more, and there the increase must be a negligible quantity, if it has not at length reached the vanishing point; and, therefore, we have to look elsewhere for an explanation of soaring.

This brings us to the subject of up currents, obviously much to be desired if wing labor is to be saved; and birds, whenever such assistance is to be had, are always ready to profit by it. When the wind blows against a cliff, it is, of course, deflected upward, and gulls may sometimes be seen enjoying the fun of being lifted like a foam bubble by the up current, then descending to

be lifted again. Oftener they may be seen soaring over cliffs or hills near the shore, ascending in noble spirals without a motion of their wings. The secret lies in the upward slant of the wind. But soaring may be seen under quite different circumstances. The adjutant bird, one of the noblest of soarers, rises till he looks a mere speck or vanishes altogether, over the plains of Burma. Can there be up currents there? It is possible that, owing to the ground being unequally heated by the sun, there may be such currents here and there. But in Egypt I have seen kites soaring over fields where the young corn was growing thick and green, and where, consequently, the earth's surface was not much heated. Probably the adjutant depends on the irregularity of the wind. Even what we call a steady wind, we know by Prof. Langley's experiments, is very unsteady, and varies enormously in velocity from one moment to another. This fact the adjutant may make use of, deriving from it the indispensable inertia or momentum. As long as he can offer resistance to the breeze, not being carried by it like a balloon, but feeling it blowing in his face, so long the breeze will continue to lift him. Whenever the wind freshens he will turn and face it, and will rise like a kite. When it slackens he will sail with it, descending slightly. Obviously there will be a good deal of leeway, a phenomenon vouched for by good observers; but there will be a gain in altitude. And thus the grand bird, making even the wind, that "chartered libertine," his slave, rises higher and higher—often, no doubt, watching as he soars for carrion on the earth below, but often, probably, delighting only in the cool upper air, and in the exercise of his own skill.

To descend now to a humbler but very wonderful performance. Gulls may often be seen following in the wake of a steamer without a motion of their wings, though the wind is blowing strong in their faces. They are taking advantage of an up current. As the steamer advances, the air at the stern rushes down to prevent a vacuum being left, and this down draught rebounds off the surface of the sea and a strong up draught is formed. The gull puts himself in this up draught, which lifts him like a feather weight, then he glides downward and onward at a great pace. Meanwhile the point at which the up draught is formed advances. He soon finds himself in it again, is raised to his former elevation, and the process is repeated.

But often a gull will hover over the stern, apparently almost motionless, in reality steadily advancing with the steamer. Here, too, there must be an up current, the wind blowing at a slight angle to the steamer being deflected upward when it strikes her side. This buoys the gull up. In rising he loses way; when he advances, he descends. But he does not descend or rise rapidly, as in the case last described. Like a consummate artist, the gull conceals the art which he employs.

For the solution of this and other flight problems more observations are needed. The interest of the subject will amply repay anyone who will devote time and energy to the study of it.—Knowledge.

[Continued from SUPPLEMENT, No. 1131, page 18078.]

PERPETUAL MOTION.—III.*

THE force of gravity applied directly to the dropping arms of wheels, or to balls which roll out in troughs, fails to make such machines operate as self-movers.

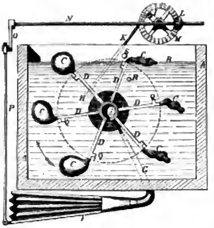


FIG. 11.

Inventors have sought often to utilize the buoyancy of floats in a similar way. The accompanying diagram illustrates this principle.

A is a cistern of water, filled as high as line B; C are six bladders, communicating by the tubes, D, with the hollow axle, E, which axle is connected with the bellows, F, by the pipe, G. H is a crank, connected with the crank, I, by the rod, K. L is a bevel wheel, M a pinion, N its shaft. O is a crank, attached to the bellows, F, by the rod, P. Q are valves with projecting levers. R and S are two projecting knobs. T is a hole in the axle, E, forming a communication with it and the lowermost bladder. The axle, E, being put in motion, is expected to carry round the bladders and tubes, and by the cranks, H and I, and the connecting rod, K, cause the wheel, L, to revolve, which, communicating a similar but accelerated motion to the pinion, M, shaft, N, and crank, O, works or blows the bellows, F, by the rod, P, from which the air enters the axle, E, by the tube, G, and passing through the hole in it at T, enters the lower bladder, C, by the tube, D; this bladder being thus rendered lighter than the space it occupies, ascends, bringing the bladder behind it over the hole in the axle, T, in like manner, and which is thereby expected to gain an ascending power, producing a similar effect on the one behind it. When one of the bladders arrives at the knob, S, the lever of the valve, Q, strikes against it, and opens the valve; when the bladder arrives at U and begins to descend, its pressure on the water drives out the air, and gives it a descending power; the knob, R, then closes the valve, Q, and prevents the entrance of any water into the bladder; by this contrivance, three of the bladders were expected to be alternately full and empty, according as they passed over the hole, T, or the knob, S.

The reason assigned for the failure of this machine was the friction, the old invincible enemy of perpetual motion seekers.

Amid all the fruitless attempts which have appeared,

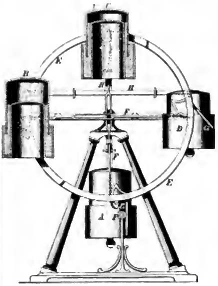


FIG. 12.

there was still one avenue to the object of pursuit, to which the common and well-known principles of hydrostatics seemed to direct the way; this was the principle that any body specifically, or bulk for bulk, lighter than common air, will rise and swim in it. Consequently, if a certain quantity of vessels are attached at equal distances, round the circumference or rim of a wheel, so contrived as that one-half of the vessels shall be exhausted on one side of the wheel, and the other half filled with air on the opposite side, in this case the exhausted vessels will attain the highest part of the wheel and the full ones the lowest. But to render the matter more explicit, we must refer to the annexed engraving, Fig. 12.

A B C D are four vessels connected to the wheels, E, by round pins which project from the vessels on each side, and enter into corresponding holes in the wheels, E. The wheels, E, are intended to revolve by the space under the vessel, B, being a vacuum, and therefore lighter than the same portion of air; a little before the vessel, B, reaches the highest point of the wheels, it begins to close, and opens the opposite vessel, D, in the same manner as the vessel, C, opens A, because the pressure of the atmosphere on the vessel, C, is equal to the pressure on A. Instead of common packing to make the vessels airtight, mercury is substituted, which has less friction, and is never out of order. The particles of mercury not being entirely free from friction, a little power is requisite to open and shut the vessels; this is expected to be effected by the rods, F, connected to the lever, G, by chains. The rods, F, give motion to other rods, H, by the rollers acting against collars on the rods, H, not shown.

The levers, G, are successively worked by sliding over the roller, P. The connecting rods, H, are so adjusted as not to draw the vessels out of their upright position, which would let the mercury escape; also, the lower vessels, A and D, are made rather larger in diameter than B C, so that the pressure of the atmosphere may counterpoise the weight of the vessels, A C and B D, with their connecting rods.

The inventor of this contrivance says:

"I doubt not in the least, that if a pneumatic machine like this were accurately executed, it would continue in perpetual motion; yet I still think the power might be greatly increased by placing the whole engine under a receiver of condensed air, say from ten to twelve atmospheres, which would weigh, if it were ten atmospheres, about twelve ounces per cubic foot."

In 1865, Herman Leonhardt, of St. Gall, Switzerland, invented a new motive power engine, which he thus describes:

"I avail myself of the property of bodies or objects of a certain specific gravity, when immersed in a fluid of a greater specific gravity, to rise or ascend to the surface of such fluid. This buoyancy represents a greater or lesser force or power, according to the greater or lesser difference between the specific gravity of the object and that of the fluid, and the size of or the displacement caused in the fluid by such object. In order to make the said objects, which I will call floats (see Fig. 13), as light as possible, and yet strong enough to resist the pressure of the water, I construct them of thin sheet metal, and in preference, in the form of tubes or hollow cylinders with flat ends. A number or series of these cylinders placed horizontally parallel to each other are hinged or linked together in a similar manner as the buckets of a chain pump; this chain of floats is passed over two sets of pulleys or disks fixed to two horizontal shafts, the one placed vertically above the other, the said pulleys being formed to suit the diameter of the floats. One-half of this chain of floats passes through the center of the tank holding the water or other fluid, and the other half passes outside the tank through the air. The floats, when in motion, enter through the bottom of the tank, in the manner hereafter described, and rise up by their buoyancy through the water; they then pass round the top pulley, descend outside the tank, and passing over the bottom pulley, again enter the tank, and so on. If cylindrical floats are used, as described, they are fixed on the connecting links half a diameter or more apart from each other; therefore, supposing the floats to be fifty centimeters in diameter, they would be placed twenty-five centimeters apart.

"Now the principal part of my invention consists in relieving the floats, when entering through the bottom of the tank, of the pressure of the water column, which pressure, if not removed or neutralized, would render the rising of the floats in the water impossible, and prevent the machine from acting. The manner in which the floats are relieved from the pressure of the water column when entering the tank is as follows: On the bottom of the tank I form an entrance chamber for the said floats of a depth equal to the diameter of a float; the bottom of the chamber and its top are each provided with double slides which open and close as the floats enter and leave the chamber. Supposing the floats to be in motion, and one of them to have arrived in the center of the chamber, a lever actuated by the moving floats or by the revolving float pulley or disk will cause the top or egress slides of the chamber to open in the same measure as the float rises; this slide, acting through another lever, will, at the same time, open a slide or valve in the side of the chamber and admit water into it, thereby bringing the water in the tank and in the chamber into equilibrium. When one-half of the float has passed through the top or egress slide, the next float will have arrived at the bottom or ingress slide, which latter will now open in proportion to the rise of the float. The egress slide will close in the same measure and at the same time shut off the communication between the tank and the chamber, which was necessary for establishing the equilibrium. At this juncture other valves connecting the chamber with pipes leading to the top of the tank are opened, and the water in the chamber, which would be detrimental to the further rise of the entering float, is withdrawn through these pipes, which I will call return pipes, by suction, and allowed to flow back into the tank above the water level; this suction is effected through the following arrangement: That portion of the top of the tank where the floats leave the water is open, but the other portion of it is covered, and a partition dividing it from the open portion is made to dip into the water to some depth, thereby rendering it a hermetically closed chamber, and the above mentioned return pipes open at a certain height above the water line into it. This chamber I call the vacuum chamber, because previous to starting the machine a vacuum or a partial vacuum must be formed in it, and afterward maintained as long as the machine is to continue in operation. The air is exhausted from the chamber by

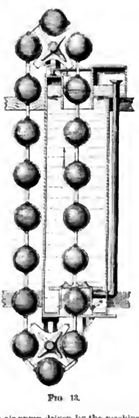


FIG. 13.

means of an air pump driven by the machine, but arranged for driving by hand for the purpose of starting the machine. By forming this vacuum the original water level in the tank will be disturbed, the water level being raised in the vacuum chamber and lowered to a corresponding extent in the open part of the tank. Supposing the tank to be of a height to hold six floats, 1, 2, 3, 4, 5 and 6, 1 being the one above described, as entering the admission chamber, it is clear that as 6 leaves the water, the water level in the open part of the tank will be lowered in proportion to the displacement previously caused by 6, and the water level in the vacuum chamber being thereby likewise lowered, it will cause a suction or drawing up of water in the return pipes, equal in quantity to the amount of water displaced in the entrance chamber by the entering float, 1. The water sucked up through the re-

* Reprinted from the SCIENTIFIC AMERICAN, 1870-71.

turn pipes will flow over into the vacuum chamber and distribute itself in the water of the tank. The ingress and egress slides of the entrance chamber are furnished with linings or packing of felt previously boiled in oil for insuring a watertight fit against the floats without much friction, and the flat ends of the floats likewise pass between sheets of felt previously boiled in oil and pressed against the flat ends by fluted rollers. The air pump is maintained in operation in order to remove the trifling quantity of atmospheric air adhering to and introduced into the tank by the entering floats. The motion communicated by the rising floats to the float pulleys or disks and shafts is further transmitted by means of belts or other gearing, in the manner usual with other motive power engines.

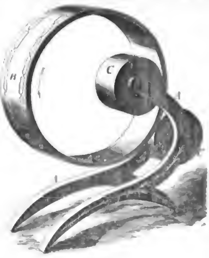


FIG. 14.

"The details of arrangement and construction of my new motive power engine may be altered or varied, but the main features of my invention consist in relieving the floats when entering the tank of the pressure of the water column by means of a vacuum chamber and parts connected therewith, as described, or their equivalents."

Only about a year since [1870] the London Mining Journal described a machine, patented in England, the essential features of which did not differ from those of Leonhardt; and what is more, expressed a favorable opinion of it.

We have received several letters with diagrams of "perpetual motion machines" from correspondents, one of which we will herewith present and defer others for future articles.

Fig. 14 is a diagram sent us by F. G. Woodward, whose address was not given in his letter.

The writer says: "It consists of a stand, A, two idler pulleys, C, between which a hollow cylindrical ring, suspended in the manner shown, is expected to revolve in the direction indicated by the arrows." The only difficulty about it is that it will not work, though it looks plausible enough.

Fig. 15 illustrates a piece of folly which, we are sorry to say, has been repeated in one form and another so

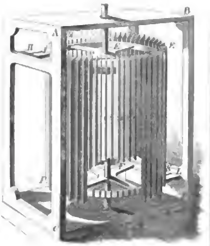


FIG. 15.

many times that it ought to be considered a standing joke, but which is nevertheless constantly turning up as a serious proposal among a class of inventors who know little or nothing of electricity and magnetism. It is the device of a Dutch inventor, Hero Hicken by name.

A B C D represents a frame of brass or wood for the machine. E F, to run in.

E and F are two brass wheels, similar and equal, fixed upon a movable axis, G.

1, 2, 3, etc., are a number of artificial magnets, placed within the teeth of the wheel all round, and as near each other as is possible, provided they do not touch; their north poles at E and their south poles at F.

H and I a. two similar and equal magnets fixed in the brass plate, A C, very near each other, but not touching.

K and L, two more fixed in the brass plate, B D.

Now, as the north pole of one magnet repels the north pole of another magnet, and attracts the south; and inversely the south pole of one magnet repels the south pole of another, and attracts the north; so the south pole, I, attracts all the north ones at E; and the north pole, H, repels all the north ones at M. In like manner, K attracts at N, and L repels at O, and by this means the whole machine, E F, is expected to move perpetually round.

Now this would be all lovely if magnets did not attract in more than one direction. Many American inventors have tried the same principle over and over, only to find their wheel standing still, and have then sighed for some septum which, interposed between a magnet and its armature, would prevent attraction while thus interposed. The editorial sanctum of the SCIENTIFIC AMERICAN has often been compelled, in answer to correspondence, to confess its ignorance of any substance of which such a septum could be constructed. Humiliating as is the confession, we never have heard of this long sought for desideratum, and what is more, we expect to leave this sublunary sphere before its discovery. But we do expect, judging from past experience, that about once a month some sanguine inventor, who thinks he has discovered the perpetual motion, "all but that one single thing," will expect us to point him the way to success by supplying to him (privately, of course) the knowledge of the septum sought.

This idea of a magnetic perpetual motion is just now the most prevalent one of all, and if what we have said shall serve to open the eyes of the many who are eagerly following what must prove to be only a delusion and a snare, our purpose will be accomplished.

Fig. 16 is an engraving of a supposed self-moving machine sent us by S. B. Davis & Company, of Detroit, Mich. They state that it is the invention of the late William Davis, of that city, who spent a great portion of his time in the attempt to make a self-moving machine.

A, in the engraving, is a tank containing water, as shown. The hollow arms, B, communicate with a hollow shaft, C, and the bellows, E; screw valves, D, being employed to increase or diminish the area of the passages in the hollow arms, B. Each of the bellows, E, carries a weight, which, during a portion of the revolution, compresses the bellows and forces the air out of

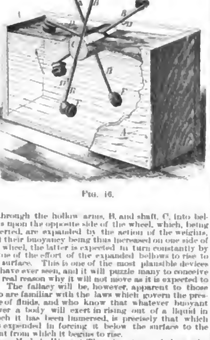


FIG. 16.

it through the hollow arms, B, and shaft, C, into bellows upon the opposite side of the wheel, which, being inverted, are expanded by the action of the weights, and their buoyancy being thus increased on one side of the wheel, the latter is expected to turn constantly by virtue of the effort of the expanded bellows to rise to the surface. This is one of the most plausible devices we have ever seen, and it will puzzle many to conceive the real reason why it will not move as it is expected to do. The fallacy will be, however, apparent to those who are familiar with the laws which govern the pressure of fluids, and who know that whatever buoyant power a body will exert in rising out of a liquid in which it has been immersed, is precisely that which was expended in forcing it below the surface to the point from which it begins to rise.

Says M. de la Hire: "There is not any of those who pretend to have found out perpetual motion, who do not agree that two weights placed in a position to move, following their natural direction in equal time, or in any way reciprocal to their weight, remain in equilibrium. Yet there is no perpetual motion scheme where one cannot draw a conclusion quite opposed to this principle; for, whatever may be pretended, perpetual motion is nothing more or less than the elevation of one weight to a certain height by the descent of another weight at the same time; and reciprocally the restitution of the first to the place where it was before its movement, by the descent of the one that had been raised, and so on ad infinitum; sometimes by means of weights, which, being raised, in their fall agitate other weights; sometimes, by means of liquid bodies, which, being raised, can run and move other parts far separated from the center of motion; from which no advantage can be derived and which is entirely contrary to the preceding principle.

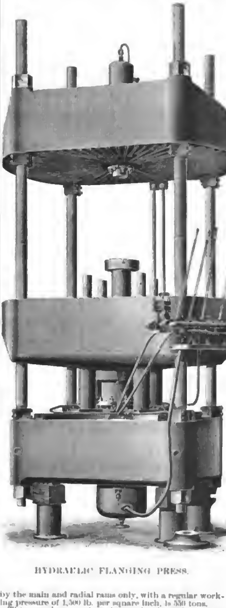
"Those who occupy themselves with this chimera find nothing but embarrassment, for generally their machines have so many weights, etc., to move them that their inventors forget always to be on their guard against the many hindrances that arise—the height, etc., of the powers employed, their natural direction, etc.—all these are sometimes so strangely jumbled together that it requires very hard work to be able rightly to distinguish them. This is one great reason that leads such persons to a false demonstration of perpetual motion; and when they propose their beautiful inventions to those who are versed in science and who cannot immediately make them see or understand in what way their reasoning is false, they then publish to the world that the very cleverest men have been convinced of the truth of their perpetual motion."

HYDRAULIC FLANGING PRESS.

HYDRAULIC flanging on locomotive boiler work, although in use for some years in this country by private railroad companies, has until recently been employed only to a limited extent in the United States. The Schenectady Locomotive Works, upon investigation of the matter about two years since, contracted for a hydraulic flanging plant with the Morgan Engineering Company, of Alliance, Ohio. The design of the press, which is illustrated herewith, was worked up very carefully with a view of adapting it to all classes of locomotive boilers in use in the United States.

The main table is 10 ft. 3 in. wide by 14 ft. long, the maximum width between the upper and lower tables being 11 ft. The minimum height between the upper and lower tables is 4 ft. and the sizes of the rams are as follows:

One main ram, 28 in. in diameter; one internal clamping ram, 14 in. in diameter; four radial clamping rams, 6 in. in diameter; one inverted top ram, 10 in. in diameter. The main columns are of steel, 7¼ in. in diameter by 27 ft. long. The total pressure exerted



HYDRAULIC FLANGING PRESS.

by the main and radial rams only, with a regular working pressure of 1,500 lb. per square inch, is 550 tons.

This press has now been in use by the Schenectady Locomotive Works for the past year and a half. The press produces, of course, work of exact uniformity, similar parts made from dies being exact duplicates in size and form, while the effect upon the steel in flanging is very much less severe than that produced by handwork with alternations of heating and flanging. It is also found that the flanges turned by the press are softer than those turned by the ordinary method of heating and flanging by hand.

The various forms of plates are heated in a large furnace, the fuel for which is oil, and after the flanging is performed the plates are still at a red-hot heat, so that the work is practically free from strains when completed.

Flanging dies have been made for their standard design of locomotives by the Schenectady Works, and the works find that quite a number of railroad companies are calling for hydraulic flanged boiler plates in their specifications—a practice which cannot be too highly recommended. The Schenectady Works are also using, as a standard practice, the pressed steel boiler

front and door, pressed steel cylinder head covers and steam chest casing covers.—Engineering.

IMPROVIDENT CIVILIZATION.*

A PLEA FOR THE APPLICATION OF SCIENTIFIC METHODS TO THE AMELIORATION OF SOCIO-ECONOMIC DEFECTS AND DISORDERS.

By RICHARD T. COLBURN.

THE responsibility you have seen fit to place upon me I will now ask you to share with me.

The controversy in respect to a bimetallic money standard, and the other as to the limits of safety for representative or currency money, are certain to be fully worked over, by the powerful vested interests concerned, in reports of commissions and printed volumes. I devote a minute or two to explaining that they are but parts of a far greater question of metrology, one also requiring for its elucidation a more exact knowledge of the laws of thought than we at present command.

The traditions of a people mould its opinions, and they change but slowly. The advance of knowledge has to overcome this inertia. Our present civilization, all types of it, are apt to be lopsided; its contour is asymmetrical; it is not abreast of the knowledge of the time, and is not yielding to mankind nearly the amount of comfort and well-being it might be made to do. To the social philosophers may be credited much of the improvement of the past hundred years. From a great number of social ills, defects and shortcomings, due chiefly to this overlapping of the childhood of the world upon its adult stages, I select a few of the more serious, which will require many centuries to correct themselves, in order to raise the inquiry among you whether it is not within the compass of human endeavor to accelerate a better state—not merely to gratify an altruistic impulse, nor yet in fulfillment of ethical ideals, but as a deliberate choice of diverging policies.

I. THE WASTE OF WARFARE AND ARMAMENT.

Ahead of its logical order, I take up the waste of war and constant preparation for war, which has haunted mankind, with few and trifling exceptions, as a malign heritage as far back as we can trace. History, whether printed in books, written on parchment, engraved on monuments, or burned in clay tablets, seems to be mainly a record of combats and glorification of warriors. Truly enough, the overrunning and subjugation of one community by another of alien looks or speech was one of the most impressive and awful calamities, surpassing in its mental impress that of earthquakes, eclipse, drought, forest or prairie fire, flood, or insect pests, because strong sinews and courage availed to give relief in one case, but not in the other. Training to arms was the ordinary occupation of life, and death by wounds, or from privations in camp, the exit, while the greatest honors were paid in primitive as in modern times to warriors.

We need not resort to any superstitious legend to account for this combative instinct; it has its analogue among the brutes which bristle up and stand on their guard at the coming of a strange figure and, in the time of scarcity, fighting for the available supply of food, shelter or females. It is even so with man; finding himself within a zone or clime-bound belt of fertility subject to periodical encroachments of the ice cap from the one direction and to the fierce suns and tropical growths on the other, hunting and fishing his principal pursuits, agriculture being nascent, there were ages when subsistence was precarious, when, along with the feræ naturæ, he was driven to the caves and trees, and had to contend for his very existence against organic and cosmic foes. The character of combatant, strengthened from generation to generation, became a first nature; he must be ever on the alert for a foe and for an occasional rival. Essentially gregarious, man could not, until very recently, associate in large numbers without engendering an artificial struggle for existence superposed on the natural.

Until the dawn of systematic agriculture, the food products of a given terrain could not keep pace with the population; not until the dawn of modern navigation was the drawing upon far distant or more fertile regions practicable; the extinction of the feeble and unskilled was therefore a foregone conclusion. Even so lately as the time of Malthus, it was held that Nature, having by her scheme of fecundity provided twenty partakers to her table spread for ten, the excess must disappear in some way by struggle or disease. It was not surprising that both philosophers and statesmen could reach the conclusion that every generation, or each quarter of a century, must have its great war in order to thin out the population to the capacity of the soil for sustaining it, or otherwise to conquer enough more territory for the purpose. The tendency of this war spirit, thus kept alive, was to diminish the population at one end of the series in order to add to it at the other. It is a late discovery that this guaranty of the sufficiency of subsistence can be more easily and effectually obtained without fighting than with it. Aside from mutual jealousy of neighbor nations, or the fear of subjugation by one or more, the policy of fighting, in order to live, can be shown to be a colossal blunder. Man need no longer exterminate his own species to escape starvation.

Had the ordeal of arms remained as it began, with a biting, scratching and wrestling, not much above the wolves, in which brute strength, sharp claws and teeth, and endurance prevailed, the perpetuation of the more warlike, and the extinction of the peaceable, must have operated to keep man closer in physique and mind to the brutes. A series of inventions of weapons, the sharpened spear, then the bow or flint tipped javelin, the arrow, the projectile, the fulminating powder, the domestication of beasts and birds—all so many triumphs of mind in the control of natural forces—enabled men to ward off the cosmic dangers and to beat back every other possible foe. Hunger and thirst and cold he had to contend with, as they had; soon he had their skins to warm him; he need not hunt his dinner before eating it; he could entrap it, and later employ the tame animals to help.

This great emotional source of wars, mutual distrust, suspicion and aggrandizement, remains with nations, as with men. When each was his own advocate, judge and executioner, the fear of combat was less than the fear of declining battle—the dread of a charge of cowardice. May we not look forward to a time when war growing out of distrust or wounded vanity shall become as obsolete among civilized people as the hunting habit, the duel, or pugilism, to which it bears a close resemblance? Perhaps, if we can demonstrate the absurdity, the folly and waste of it, we may do something to banish oppressive armaments; but the war impulse is scarcely amenable to reason, or to considerations of profit and loss; it is more vulnerable to ridicule and to the banishing of deep seated prejudices. This power of fear, rivalry and suspicion being an inherited mental trait, dating far back in man's career, nurtured by song and story, embellished by poetry and art, stimulated by a religious enthusiasm, will die slowly. Like the beliefs in fairies and witches, they are not to be uprooted by argument alone but must be outgrown.

The devolution of the fighting trait may be traced, where one would least expect to find it, among the females. Women, young and old, higher and lower, instinctively, as we say, admire physical bravery, often in preference to moral courage. The very same badges and insignia of war stir the fierce emotions more than in the males. The showy uniforms, music and bearing, the plaudits of victory, rouse them to unwonted enthusiasm. Favor is extended to the side of the conquerors, disfavor to the vanquished, as eagerly as compassion on the wounded and dead. Unconsciously it may be, women are great aids to the recruiting sergeant, and to the gladiatorial shows, pomps, pageants and circuses. The songs of all nations reflect this powerful stimulus toward battle. "J'aime que le militaire," "The bold soldier boy," is the tenor of them; and, as if to intensify and keep alive the belligerent instinct, the boy children are still given weapons as playthings. Very rare are the plaintive songs in denunciation of war. I remember one such in fashion in the first half of the century. It ran something like this:

"If I were King of France, or still better, Pope of Rome,
I'd have no fighting men abroad, no weeping maids at home,
But the world should be at peace; and if the kings must show their might,
Then should those who made the quarrels be the only ones to fight."

Traces of the same surviving habit, grown dim from disuse, are found in the fainting or swooning disposition at the sight of flowing blood. A variation of this may be found in an attack of frenzy, or fury, from the same cause. This trait is also noticeable in some animals which are excited by the red color alone. The expression "war fever" is apt; it begins in delirium and ends in lassitude and exhaustion. The persistence of the belief that "blood letting" is the natural cure for personal or social ills is a survival of the same kind. The passion for military prestige—la gloire—which so long haunted the Romans, and later the French, and is now conspicuous with their neighbors, is a fatal inheritance which lingers along with great intellectual power.

When one speaks of "firing the national heart," appeal is made to this latent instinct, and it rouses the inbred emotions in much the same way as its opposite emotion, the stampede of panic. Something of the same cruel homicidal impulse is to be seen in the old fashioned "hue and cry" against alleged infractions of decency, loyalty or sacrilege and in the craze of mobs for lynching. Strategy and artifice may avail to divert it, or lead it to harmless issues, but it cannot be extinguished at the onset by threats or any reason short of that of exhaustion by superior force. This accentuates the danger, at all times along frontier lines, of an incident of encroachment or insult which may serve as a spark to ignite combustibles. The great concern of statesmanship is to keep this latent tendency from flaming into open war. "The cancer of a long peace" no doubt reflected a state of society in which industry was dislocated, when possessions were held by the strong arm, which indeed must have been wretched to make a state of war more tolerable.

Man will fight to expel intruders upon his domain, to resist capture, to overcome sexual rivals, to protect his family and to preserve his altars and property. Modern wars spring more frequently from the latter than from all other causes combined; to be secure in the enjoyment of property, excuses and renders possible the armament of advanced nations as a reserve of police force, to maintain domestic peace and order, although the supplies are generally voted after artificial war scares. Holders of wealth are willing to be taxed to insure tranquillity at home, even at the risk of personal conscription, rather than be left at the mercy of mob violence. Such is the irony of our civilization that some of the leading nations manage to combine a treble profit by fomenting or permitting wars in which the combatants become customers for arms, ships and munitions, and also for loans of money.

An appeal to force, to establish and maintain any degree of equality or inequality of fortune, is a mistake. It puts force in the place of equity; fixes right by might; moreover, it fails of its object; armament for domestic purposes excites alarm among neighbors, who have similar pretexts, and thus the Sisyphean task is kept up. Besides, it tends to invest property holding per se with a sacredness which ought not to belong to it.

The maxim of aggressive statesmen, that "constant preparedness for war is the best security of peace," is a seductive, dangerous half truth; it is about equivalent to the old adage that every gentleman should spend an hour a day with foils and pistols to keep himself in practice against intruders, assassins or robbers. Some ultimate appeal to force, of course, there must be; but, like the enforcement of decrees of courts, it should rather be in posse than in esse.

The world presents, at the close of the century, three very instructive object lessons in the policies and prospects of three continents—Europe, Africa and America. When the first Napoleon made his menacing prophecy that "in fifty years Europe would be either all Cossack or all republican," he indicated correctly enough the two opposing forces between which it is kept in unrest and arms. He simply underestimated the time for working out. The six great powers waiting for the recovery, or expiring gasp, of their feebler neighbors, in order to obtain a share of their estates, is a sad spectacle. How many more furious struggles is history to record for the control of the Levantine shores? What a satire on civilization—not to speak of Christianity—to find the youth of Europe armed for such wanton waste! Turkey, Austria, Greece, the Balkans, Spain, Holland—is their fate to be absorption into a stronger empire? and if so, into which, and for how long? The epithet "cockpit of Europe" is one of warning to other continents.

We are permitted to identify Germany with the dominating policy of Europe because it is setting the pace, assuming the role of fencing master and armorer to sister states (and shamelessly supplies them with weapons, money and tutors to carry on the strife); and because it so successfully combines medieval feudalism, dynastic government and state church with the most advanced science and knowledge in the arts. Hence we find chancellors and reigning emperors alike claiming the usual kingly commission from Deity, the favor of the Almighty, but at the same time making open treaties with one set of powers, secret treaties with another set, and, as if in distrust of all such allies and auxiliaries, providing also the heaviest battalions and best artillery.

How unfortunate, in one sense, is the situation of the African continent in not being permitted to receive the blessings of European civilization without its attendant curses. How much better it would have been to have consolidated the whole into one, or at most two, great commonwealths with a single republican form of government, one standard of loyalty, one language, religious toleration, common jurisprudence, freedom of internal commerce, facile postal and personal intercourse, uniform measures and coinage; instead of the partition into so many reproductions of European differences of flags, creeds, politics, customs, usages, speech, each with its patch of shore front and a vast tract of hinterland to be fortified, defended and jealously watched in perpetuity. It is as if by inoculation the pest virus were poured into youthful arteries. The picturesque old cradle of Mediterranean civilization, now lying isolated from, and yet so close to, the barbaric types, deserved some nobler treatment from the enlightened powers than this selfish spoliation. The opportunity to dedicate deliberately one-quarter of the globe to peace and culture apparently has passed forever.

The dream of a peaceful consolidation of nations—a political millennium—is quite old. Fortunately there are other potent forces at work making for peace. Good will and good neighborship are also inherent emotions. Among these may be reckoned the comity of nations, perhaps also religious propaganda, foreign trade and intercommunication. The late Secretary Blaine set a notable example of the peacemaking impulse when he addressed his eloquent words to the convened representatives of American republics, counseling unification of policies, arbitration of disputes between themselves, and urging again the Fathers' doctrine of "America for Americans." This condensed motto is frequently misunderstood as implying a sort of hostile coalition against Europe calling for a hostile coalition by Europe. It is simply a forecasting desire not to be embroiled in European neighborhood disputes about boundaries, dynasties, creeds, alliances, easement rights to ports, etc., from which America can keep aloof and should be encouraged to do. That invitation, for obvious reasons, omitted the Dominion of Canada. In any future conference it is to be hoped Canadians will see their way clear to participate, in this, as in other prerogatives of self-government, as they have a joint interest in the welfare of North America politically, scientifically and economically.

That the international comity, and if you please the jubilee features, of the year may not be neglected (in which, however, science is thrust far in the background), as an American response to the very hospitable suggestion of Prof. Dicey—probably drafted before the failure of the general arbitration treaty—of a common citizenship for the people of Great Britain, her colonies and offshoots, the United States being specially included, let us say: Unworkable though it be, it is received as an expression of good-will. I venture to offer instead the counter proposition that we might have with Canada a Zollverein treaty abolishing fortifications, fleets and custom houses along the four thousand mile frontier, letting the tariff revenues be collected at the seaports. Reciprocity of language, traditions, laws, coinage, metrical systems, postage and railroad conveniences we have. By a larger interchange of merchandise and ideas, together with the freest intercourse, the benefits to be derived by both parties are so great that any sacrifice on either side would be insignificant, temporary and easily borne.

Modern warfare is becoming more and more a contest of ingenuity and material resources. Numbers or physique of combatants count for less, and even personal prowess is of less importance. Craft in strategical maneuvers remains as of old. Machines, explosives, transport, commissariat, surgical skill and adjustment of knapsack and accouterments are now paramount. Success depends also on industrial production and intellectual power. National debts, formerly supposed to be aids to peace, have become incentives to war; financiers often find a joint interest with diplomats, purveyors and soldiers, in fomenting or permitting wars to go near the point of danger for dynasties and capital. How to escape from the meshes of this combination is one of the most portentous and baffling of problems of politico-economic science. Following the analogy of guaranty and insurance corporations, it might be well for Europeans to invite proposals from the house of Rothschilds and its affiliations for a stipulated sum for which they will guaranty peace between the several members in lieu of the present onerous exactions of war loans. The financing of governments has become so large a vested industry that it demands the right to live, like some other institutions we shall have occasion to discuss, and society can neither get along comfortably with them nor extinguish them without violence. Let there be started a rumor of an invasion, blockade, or a vote for new ships and arms, by one of the number, the cabinets of Europe are in instant trepidation. The legislative assemblies at once catch the craze—up go the budgets,

* An address before the Section of Social and Economic Science of the American Association for the Advancement of Science, August, 1897. Mr. Colburn is vice-president and chairman of this section.

out go the contracts for munitions and war loans and then fluctuation in the bourses. Somebody presently discovers it was a fictitious, exaggerated alarm, and the agitation subsides, but the taxes remain just the same.

In Mulhall's recent work, "Industry and Wealth of Nations," are the figures of the national debts of Europe with an attempt to segregate that portion incurred for railroad and public works which latter are in many cases part of the military regime. The figures are impressive, but fall far short of expressing the total money cost of armament, to say nothing of the loss of public and social morale. The burden of industry is thrown upon the children and aged women, increasing the hours of labor and lowering the scale of living.

With a due sense of humiliation, we must confess that no single remedy can be found for this unhappy tangle of affairs. Parliaments, by their constitution, represent the opinions of ministerial governments, and are not themselves exempt from war fright. It is a common trick of failing ministries to strengthen their hold on power by resort to menaces and scares. The presence of one unclouded, undaunted mind at the time of panic of the multitude is a priceless desideratum; it is as cheering as the advent of a cool, competent surgeon into a room full of hysterical bystanders around a prostrate patient. Presence of mind, ridicule, satire, caricature and especially comic cartoons are more likely antidotes than argument. The disease is in good part psychic and the remedy must be of the same kind.

Again, therefore, we may say science, including its socio-economic branches, is our best hope for peace and disarmament. Among the suggestions containing more or less of promise, the following are worth mentioning:

(a) The Swedish Prof. Nobel, who accumulated an immense fortune from his nitro-glycerine inventions, has left a large fund to promote the extinction of war by making it so deadly that nations will be afraid to resort to it. Evidently when commanding generals are themselves brought within the range of unseen, and practically irresistible, dangers, they will not be so eager to seek this method of promotion. The stoutest heart quails before a stream of electricity, hot steam, asphyxiating gas or explosives rained from an air ship.

(b) Soldier and civilian are alike interested in maintaining a high standard of health and efficiency, the former having more depending on his doing so. Selected on account of his physique, the soldier should have more than the average intelligence, and if the army regulations or the instruction of the superior officers teach him how to care for himself, to moderate his passions, and endure privations, it will be a small compensation for his detachment from the industrial ranks. Sanitary and personal hygiene are of the utmost importance to the perpetuity of armies, nations and races.

(c) Continuance of the diplomatic methods, cumbrous as they are, must be assumed, although their function is becoming dimmer in the presence of telegraphs, telephones, newspapers and popular participation in national councils. Diplomacy has been at all times under suspicion of insincerity and deceit; but it has the great merit of defining in language the grievances and causes of war, which gives time for passions to cool. Armies are now massed while diplomacy is getting ready; collision comes before the causes can be stated.

(d) Courts of conciliation are an improvement in diplomacy in that they also give time for passions to subside. They do not, however, prevent armament; and armaments are ipso facto provocative of hostilities. They will still be needed as against non-arbitrating parties. The binding force of treaties, not always scrupulously observed, is being weakened by the example of conspicuous breaches. Great Britain and the United States may creditably vie with each other in setting the world an example of this mode of preventing and settling disputes.

(e) To the above, I would fain offer a further suggestion aimed at those who have the responsibility of deciding upon war or peace. The actual ruler, whether it be a parliamentary body, or a President or Chief Secretary, King or Chief Minister, Kaiser or Chancellor, Sultan or Vizier, should be required to obtain the sanction of some deliberative body, not of his own creation or selection. In addition, every such officer should be required by fundamental law to surrender his office, authority and emoluments into the hands of such an assembly, at intervals diminishing progressively with the duration of his reign; such council or parliament to be at full liberty to restore it, farther limit it, or to confer it upon a successor. Such a check upon the inebriety of power and incident flattery is needed as a safeguard against aberration of intellect or perversion of moral balance. The temptation and strain upon the faculties of one who is the fountain of honors and promotions ought not to be imposed without some such restraint. The tendency to hero worship is truly a psychological taint, pregnant with dangers enough in the populace and positively ruinous when reflected on a single mind not chosen for robustness.

In this momentous struggle of medieval types against popular forms of government in continental Europe, occupied by three millions of armed men, and seven to ten millions more subject to call, the Britons and Americans jointly owe a duty to the cause of civilization and peace, not to be swayed into the same mad folly.

(To be continued.)

A SKELETON FACTORY.*

ONE day I saw a funeral cortège leave La Roquette (the Newgate of Paris). I followed it to the cemetery of Les Champs des Navets, Ivry, and found that it was that of an Anarchist who had just paid the last penalty for his misdeeds. The rude coffin and few attendant officials reached the place of burial; the priest read the service for the dead beside the open grave, which was quickly filled in, but only the coffin was buried, for, as I afterward learned, the body was sent to the schools for dissection. It is the merciful custom in France to deliver the bodies of criminals to their relatives and friends, but when unclaimed they are sent to the dissecting pavilions for the use of medical students, after a mock funeral such as I had witnessed. Ultimately the skeletons find a place in the Anthropological Museum, where they are duly classed and labeled, so that the public, or rather the student, can study the peculiarities of criminal anatomy. Once I had obtained a clew, I quickly discovered the beginning and the end of skeletons; but the intermediate stages in which a body is stripped of flesh, muscles, nerves and tissues, and becomes transformed into a mere primal osteological structure, was still a mystery. Medical men, students, hospital officials and curators of museums were, I found, profoundly ignorant when questioned on the subject of the preparation of skeletons, but one and all unanimously repudiated the existence of a skeleton factory. It was useless to suggest that there must be a place where by some process the flesh was removed, the bones whitened and properly put together by skilled hands, as we see them in museums and studios. That this was done they admitted, with a shrug of the shoulders, but the where and the how no one would reveal.

At last, however, I found the place I wanted, and after many repulses, succeeded in getting the information required, and also in obtaining permission for an artist to make some sketches. I learned that dissection in the hospitals is not allowed. All bodies unclaimed after a certain time are sent to the dissecting pavilions of the medical schools for the use and instruction of the students, and when finished with there, they are conveyed to a place, the name and locality of which I am not at liberty to divulge. Here the head, trunk, and limbs are cleared entirely of flesh, the bones bleached and afterward treated to a course of preservatives, and finally put together by skilled anatomists. These various processes take twelve months. The factory is under government supervision. The proprietor is a rich man, the business being his sole monopoly. In addition to his place in Paris, he has two branches in London and one in New York, and a separate department for stuffing and skeletonizing animals and birds. The bodies of criminals are sent from the dissecting schools to the factory, and also many specimen bodies of different races sent home by travelers—decomposition having been first arrested by chemical preparations and injections—are received and here prepared for the anthropological museums in different parts of the world. As soon as the bodies, heads or limbs, as the case may be, reach the factory, they are placed in tanks filled with water and phenic acid, which is continually changed. They are afterward boiled in strong soda water, and again immersed in the tanks. This first stage occupies several months, and the details are far too gruesome to describe. The chemicals used in this process, and also for whitening and preserving the bones, are trade secrets.

Let us visit the stockrooms. Here are shelves full of skulls of all sizes, shapes, and races, some which, by accident, or in the interest of science, have been broken into pieces and neatly put together again with brass wires; drawers full of minute bones, and vast heaps of ribs and larger bones, mysteriously lettered and numbered. In the next room workmen are engaged in piercing the bones and preparing them for the wirers. We will pass through the laboratory and the warehouse—where we see stacks of wire of various thicknesses, springs of all kinds and sizes, stands for mounting the skeletons, and all the tools employed in putting them together—to the workrooms where the finer part of the work is done. Here the dry, fossil-like bones are united to their component parts. Some workmen are engaged in putting together hands, others feet, while several are employed in repairing skulls or fastening springs to various parts to render them movable or otherwise, according to the purpose for which they are intended and ordered. The completed limbs and skulls are then carried into an adjoining apartment, where the whole skeleton is put together, and finally mounted on a stand or attached to an iron rod, while others have a ring inserted into the skull, by which they may be suspended. From this department they are sent to the packing room and carefully boxed and dispatched to their destination, while others are placed in stock for selection by intending purchasers.

* M. Dinorben Griffith, in Pearson's Magazine.

UNITED STATES CAVIAR IN EUROPE.*

AFTER a careful investigation of the matter, based chiefly upon information received from a firm of this city which imports about 70 per cent. of the caviar entering Germany from the United States, I would express the opinion that there exists a growing and profitable market for this article in this country, as well as in other countries of Europe.

The first importation of the United States caviar into Hamburg was made twenty-nine years ago (in 1867). The shipment consisted of from 20 to 30 kegs of 135 pounds each, the price paid in America by the importers being 2 cents per pound. The caviar came from the Delaware River, from which locality comes 50 per cent. of all the United States caviar now imported here. Four thousand kegs of about 140 pounds net each might be given as the total quantity. Both lake and river caviar are brought to this country, chiefly from the Delaware River, Georgetown, D. C., Chesapeake Bay, the Fraser and Columbia rivers, the Great Lakes, and the Lake of the Woods. Lake Michigan has been entirely fished out. The supply from Lake Huron and Lake Erie has grown quite limited, while that from Lake Superior remains good. The largest quantity comes from the Lake of the Woods. Lake caviar is preferred to that from the rivers, on account of its larger roe, the latter being small and black in the river caviar.

Nearly half of the importations of United States caviar is consumed in the cheap restaurants of Berlin; three-fourths of the other half goes to Austria, and the rest to Italy and other European countries. The importations are increasing, because the article commands a better price here than in the United States and because the supplies of the Elbe and Vistula are decreasing each year. Competition with Russia is possible on account of prices and with Germany on account of the growing scarcity of the native product, as above alluded to, and the larger roe of the American caviar. Holland ships a little caviar to Germany—about 300 pounds annually; the quality, however, is poor.

* United States Consular Report.

Elbe caviar sells here for about 3 marks (72 cents) per half kilogramme (1.02 pounds); Russian sells for about 10 marks ($2.38) per half kilogramme for good medium quality, the highest grade bringing 13 to 14 marks ($3.09 to $3.33) per half kilogramme. These figures for the Russian caviar are the prices in the free harbor, that is, without duty of 75 pfennigs (17¾ cents) per half kilogramme.

Delaware caviar, I am told, cost at home, in 1893, from $25 to $28 per keg, and, in 1896, as high as $46 per keg. The prices this season are likely to equal those of last year.

Lake caviar was sold last year in the United States as high as $90 per keg of about 140 pounds net. While I cannot vouch for the statement, I have been informed by the leading firm here that the highest amount ever received in this market for lake caviar was 2⅛ marks (50⅝ cents) per half kilogramme without the duty. This price includes, however, an apparent loss in weight of 10 per cent, as the difference between American and German pounds, the freight from the lakes to Hamburg, cold storage, brokerage, commissions, etc., and 10 per cent. allowance for spoiled goods.

United States caviar is sold here by German pounds net, and, strange to remark, is salted at home with German salt, which is sent there for the purpose. It is claimed that it possesses preservative properties superior to those of American salt. Even the caviar from as far west as the Columbia River is treated with German salt.

The freight from New York to Hamburg is about 2 marks (47½ cents) per keg, or 4 marks (95 cents) if shipped in refrigerators. The high freight from the lakes to New York is an unfortunate expense to the export trade in this article. Another serious disadvantage to our product is the equal specific duty of 75 pfennigs (17¾ cents) paid by Russian and American caviar on entering Germany, which operates unfavorably, because our article is so much cheaper.

With a view to increasing the popularity of United States caviar in this and other European markets, which an effort should be made to win, it is respectfully suggested to our dealers and exporters that not less than 14 pounds of salt should be used in preserving 100 pounds of roe, to which about 2 pounds of preservative salt should be added. Under such treatment, it is confidently claimed that the caviar could not possibly spoil. The Columbia River packers who now use pine wood kegs, which are too light, should substitute those made of oak. I shall be most happy to do anything in my power to place our exporters in communication with reliable parties in this city handling United States caviar.

W. HENRY ROBERTSON, Consul.

Hamburg, February 27, 1897.

VILLAGE INDUSTRIES OF RUSSIA.

THE most noticeable feature of Russia, as distinguished from western European industry, is the more intimate connection of the former with rural economy. This means that to this day, at any rate in the majority of cases, the Russian factory hand does not abandon husbandry in his own village, but strives to maintain his connection with the land, and that trades in Russia are developed to a far greater extent in the villages than in the towns. According to a report issued from the Chancery of the Committee of Ministers, St. Petersburg, in ancient Russia the town still retained comparatively more importance for industry. In the Moscow period, however, with the strength of the power of the government, and the decline of the autonomy of the towns, trades began to be concentrated in the villages, whence craftsmen began to visit the towns only for temporary engagements on hire, or to execute the Tsar's tasks as a duty. The causes of the concentration of handicrafts in the villages were many. Town life was very feebly developed, the towns themselves differed little from villages, and in the village, husbandry alone did not always and everywhere afford a living to the peasantry, as is the case also at the present time. On the other hand, the prolonged winters, especially in central and northern Russia, left a great deal of spare time. In this village industry, or, as it is called, "koostar" industry, besides the head of the family, the other members, both men and women, take part in the work, and, not unfrequently, children of seven to ten years of age. In some trades, particularly in those of lace making and weaving, women even take the chief part. Village industries, in the course of their long history, have elaborated peculiar technical methods of their own, and a certain division of labor. Thus, for example, one part of the work is performed by children, another by adults, and a third by the aged; or in one village, one part of the article is made, in another neighboring village, another part, while in a third, the parts are put together, and in a fourth, painted. Under these conditions, koostar industry has continued to develop, notwithstanding even that the cheapness of peasant labor, and of materials, and the immense competition resulting from these causes, and the difficulty of sale, have considerably reduced the prices for these goods. There are now in all over fifty distinct kinds of village or koostar trades. Without dwelling upon their description, it will be only necessary to say that, in accordance with local conditions, the village artisans or koostars are employed above all in the manufacture of articles from wood. There are as many as 80,000 households employed in making baskets, mats, wheels, carts, buttons, spoons, and even furniture and coffins. The northern flax growing districts manufacture linen tablecloths and towels. The central districts take orders from the manufacturers for weaving the commoner cotton goods. More than 150,000 men are occupied in the preparation of leather. As many as 19,000 peasant households are employed in the manufacture of hardware. Particularly well known in the last respect are the villages of Pavlovo, Vorsma and Bezvodnoe, in the government of Nijni-Novgorod. Together with the extensive koostar districts adjoining them, these villages earn very considerable sums each year, and Pavlovo has, on account of the excellent workmanship of its cutlery, gained the name of the Russian Sheffield. If to the above mentioned industries be added the "samovar" industry in the Toola government, the painting of images on wood, lace making, and the manufacture of toys, this will complete the enumeration of the principal branches of koostar production. It is impossible to arrive at the total value of the production of such goods in Rus-

sia, from the absence of any reliable data. An equal uncertainty exists as to the exact number of persons employed in koostar industries. Some investigators fix it at 6,000,000, or four times that of the factory hands and miners. In any case, even these approximate figures are a clear indication of the importance of koostar in Russia. In some branches of industry, it stands higher, in regard to the value of the output, than that of the factories. For example, in the leather trade, the production of the manufactories is estimated at from £3,700,000 to £4,200,000, while that of the koostars reaches £5,800,000. The question as to whether koostar industry in Russia is doomed to be absorbed by manufacturing industry on a large scale is a moot one. In that country the solution of this question depends not only upon the advantages of production on a large scale over small production, in the sense of the application of improved methods, cheapening the work of machinery, etc., but also upon the need of the koostar for agricultural earnings; for so long as these earnings possess for the peasant sufficient importance for him to regard the koostar industry as a supplementary one, so long will he be in a position to reduce the price of the articles he makes almost to that of the material, and not to aspire to such a wage as would secure his independent existence. Taking, however, everything into consideration, the Russian koostar industry is stated to possess many elements for a prolonged existence and for considerable development. The most important measure for the improvement of koostar productions, and of the economic conditions of the koostars themselves, must be regarded as the extension among them of technical knowledge, of credit and of stores for the sale of koostar goods in the great towns, etc. These questions have lately been receiving the most careful attention from the government and the rural authorities (Zemstvos). There is a remarkable collection of the products of koostar industry in the St. Petersburg Agricultural Museum, and koostar exhibitions are organized in other parts of Russia.—Journal of the Society of Arts.

AN ASHANTEE KITCHEN.

THE ASHANTEES IN THE ZOOLOGICAL GARDENS AT VIENNA.

THE zoological gardens of Vienna have lately been visited by a troupe of negroes from the territory between the Gold Coast and the Ashantee country. By a stretch of the real meaning of the name, these are commonly designated Ashantee negroes.

It appears that on a former visit the negroes were so favorably impressed by Vienna and its inhabitants that they have now returned in increased numbers. They are indeed treated with such regard and sympathy that their sojourn on the banks of the Danube becomes a thoroughly enjoyable time for them. The colored men and women, and particularly the little negro children, have made themselves quite favorites with the visitors of the zoological gardens, whose number amounts to twenty or twenty-five thousand on holidays.

These Ashantees constitute a very interesting subject for study in ethnology, and all the more so because their general conduct and their performances are natural and true, free from those artifices calculated to produce sensation, which so often deteriorate similar shows.

The negroes, as we find them in Vienna, do not by any means represent the lowest and utterly uncivilized class of Africans. For centuries Portuguese, Dutchmen, English and French have traded on their shores, and have built forts and colonies. Missions, too, have been carried on, and some of the Vienna guests are Christians, and even speak a very broken English, but the mass of them have retained their primitive language and customs in their full originality. They show clearly how slow the development of culture is in those African territories.

MAN SPOOLING WOOL.

The Ashantees are accommodated in the gardens in very cleanly huts of native construction. Each hut gives shelter to one family. The whole troupe is under the rule of a chief, who is responsible for their conduct to the English consul. He carries a staff, which he has, however, no occasion to use, as his people obey him instantly on the least sign from him. He watches his people jealously for the keeping of good order and morals, and is assisted in this task by the married men and women.

Ashantee customs make married women of girls from twelve to thirteen years of age. The women, who are not, as a rule, long lived, have neither beauty nor grace. They carry their children upon their backs, in consequence of which custom they become fitted with a natural support in the form of a cushion of fat, which has been connected by analogy with the similar decorations of the burden bearer of the desert—the camel.

These negro women are very cleanly, and the picturesque folds which constitute their dress are always of absolute purity. Among the children some charming creatures are found. The little boys and girls show a remarkably gay and peaceful disposition, and behave exceedingly well in the school, which is held by a negro schoolmaster, and where they do their writing in kneeling posture. In their spare time they amuse themselves in various ways, very much like white children. Some of the men follow various occupations as artisans, and, in spite of their primitive tools, turn out very creditable products. Thus some are smiths, others weave mats and baskets, some are boat builders, and even goldsmiths. One of our illustrations shows a man spooling wool. His device for doing this work is very ingenious. In one hand he holds the spool, a rotating stick supported at one end in his hand and at the other on the ground. We see that he has even taken the trouble and had the good sense to furnish this part of the apparatus with a small fly wheel. The second part of the apparatus shows how simple things may serve for good ends. Here a bottle makes a very good bearing for the rotating reel from which the wool is wound by giving it an occasional impulse.

The women, carrying their children, are employed in the kitchen, cooking the meals on primitive fireplaces. The yam root, which forms the chief food in their native country, is supplanted during their stay in Europe by the potato, which is mashed and served in balls. The kitchens are not particularly appetizing, but one step they have already advanced, for enameled tin pots have come into use. Our illustration shows a group of women engaged in various kinds of kitchen work. We see one churning, two others peeling potatoes, while a third, smoking a pipe, and carrying a child on her back, is apparently taking a rest.

The chief attraction, however, of this negro colony is found in the original performances of the Ashantees, which include singing and dancing, a procession led by the chief, and battle scenes. In the singing and the playing of their musical instruments these negroes show an untiring zeal. Most of them belong to the musician caste, which in Africa play a similar part as the gypsies do in Hungary, except that the services of the latter are required only on joyful occasions, while the former do not by any means restrict their productions to such times. They make their music part of their religious ceremonies, and consequently resort to it on all occasions. Their dances, too, are religious rites. One of them, if once begun, must be continued till nightfall, no matter how early in the day it may have

commenced. Our illustration represents some of these blacks engaged in the performance of one of their dances, known as the handkerchief dance.

It is in the evening, when the day's work is over, that the good time for the negroes sets in. Attentions, which are not wanting by day, are now lavishly poured on them. Men and women, but particularly children, are asked to partake of the evening meal with the white visitors. It is a comic sight to find the majority of tables of the park restaurant occupied by a motley company of black and white, to see richly dressed ladies and gentlemen joking playfully with little colored children. The older children accept these attentions with simple grace, and enjoy greatly the privilege of eating with knife and fork.

This visit of the Ashantees has proved a help in need to the zoological gardens at Vienna, for affairs had taken a very bad turn, and a total breakdown was feared, while under the present circumstances a promising turn of the tide has set in, which, it is hoped, will enable the institution to live through the apparently hard times.

Our illustrations are taken from Illustrirte Zeitung.

THE HANDKERCHIEF DANCE.

THE BRITISH ASSOCIATION—ADDRESS IN GEOGRAPHY.

THE address in Section E was delivered by Dr. J. Scott Keltie, Sec. R.G.S., who, after some preliminary remarks, said: There is a prevalent belief that geographers have nothing more to learn in Europe—that that old continent has been thoroughly explored. It is true that nearly every country in Europe has been, or is being, trigonometrically surveyed. Except some parts of the Balkan Peninsula and north of Russia, the topography of the continent has been accurately mapped on scales and by methods sufficient at least for the purposes of the geographer. Yet there are districts in the Balkan Peninsula—for example, Albania—which are as vaguely known as Central Africa. But it is a delusion to think that because a country has been fully mapped the occupation of the geographer is gone. It is only when a region at large is adequately mapped that the work of geographical research begins. The student, with a satisfactory map of a definite district as his guide, will find on the spot abundant occupation in working out its geographical details, the changes which have taken place in its topography, and the bearing of its varied features upon its history, its inhabitants, its industries. This kind of work has been in progress in Germany for over ten years, under the auspices of the Central Commission for the Scientific Geography (Landeskunde) of Germany, with its seat at Stuttgart. Under the collective title of "Forschungen zur Deutschen Landes und Volkskunde," a long series of monographs by specialists has been published, dealing in minute detail with one or more aspects of a limited district. Thus we have such memoirs as "The Plain of the Upper Rhine and its Neighboring Mountains," by Dr. Richard Lepsius; "The Towns of the North German Plain in Relation to the Configuration of the Ground," by Dr. Hahn; "The Munich Basin: a Contribution to the Physical Geography of Southern Bavaria," by C. Gruber; "The Mecklenburg Ridges and their Relation to the Ice Age," by Dr. E. Geinitz; "The Influence of the Mountains on the Climate of Central Germany," by R. Assmann; "The Distribution and Origin of the Germans in Silesia," by Dr. K. Weinhold; "Mountain Structure and Surface Configuration of Saxon Switzerland," by Dr. A. Hettner; "The Erzgebirge: an Orometric-Anthropogeographical Study," by Dr. J. Burgkhardt; "The Thuringian Forest and its Surroundings," by Dr. H. Pröscholdt, and so forth. There is thus an inexhaustible field for scientific geography in its most comprehensive sense, a series of problems which may take generations to work out. In a less systematic way we have similar monographs by French geographers. One or two attempts, mainly by teachers, have been made in England to do similar work, but the impression generally produced is that the authors have not been well equipped for the task. I am glad to say that in England the Royal Geographical Society has initiated a movement for working out in a systematic fashion what one may call the regional geography of the British Islands on the basis of the one inch maps of the Ordnance Survey. It is a strange thing that the geography of the mother country has never yet been systematically worked out. Taking the sheets of the Ordnance Survey map as a basis, it is proposed that each district should be thoroughly investigated, and a complete memoir of moderate dimensions systematically compiled to accompany the sheet, in the same way that each sheet of the Geological Survey map has its printed text. It is a stupendous undertaking that would involve many years' work, and the results of which, when complete, would fill many volumes. But it is worth doing; it would furnish the material for an exact and trustworthy account of the geography of Britain on any scale, and would be invaluable to the historian, as well as to others dealing with subjects having any relation to the past and present geography of the land. The librarian of the society, Dr. H. R. Mill, has begun operations on a limited area in Sussex. When he has completed this initial memoir, it will be for the society to decide whether it can continue the enterprise or whether it will succeed in persuading the government to take the matter up. I refer to work of this kind mainly to indicate what, in my conception, are some of the problems of the future which geography has to face, even in fully surveyed countries. Even were the enterprise referred to carried out, there would be room enough for special researches in particular districts. But while there is an inexhaustible field in the future for geographical work in the direction I have indicated, there is no doubt that much still remains to be done in the way of exploring the unknown, or little known, regions of the globe. Let us briefly refer to the problems remaining to be solved in this direction. Turning to the continent of Asia, we find that immense progress has been made during the past 60 years. In the presidential address given 60 years ago, already referred to, Mr. Hamilton says of Asia: "We have only a very general knowledge of the geographical character of the Burman, Chinese and Japanese empires; the innumerable islands of the latter are still, except occasionally, inaccessible to European navigators. Geographers hardly venture on the most loose description of Tibet, Mongolia, or Chinese Tartary, Siam, and Cochin China." Since then the survey of India—one of the greatest enterprises undertaken by any state—has been completed, and is being rapidly extended over Burma. But I need not remind you in detail of the vast changes that have taken place in Asia during these years, and the immense additions that have been made to our knowledge of its geography. Exploring activity in Asia is not likely to cease, though it is not to be expected that its inhospitable center will ever be so carefully mapped as have been the mountains of Switzerland. The most important desiderata, so far as pioneer exploration in Asia is concerned, may be said to be confined to two regions.* In Southern and Central Arabia there are tracts which are entirely unexplored. It is probable that this unexplored region is in the main a sandy desert. At the same time, it is, in the south at least, fringed by a border of mountains whose slopes are capable of rich cultivation, and whose summits the late Mr. Theodore Bent found, on his last and fatal journey, to be covered with snow. In exploration, as in other directions, it is the unexpected that happens; and if any traveler cared to face the difficulties—physical, political and religious—which might be met with in Southern and Central Arabia, he might be able to tell the world a surprising story. The other region in Asia where real pioneer work still remains to be done is Tibet and the mountainous districts bordering it on the north and east. Lines of exploration have in recent years been run across Tibet by Russian explorers like Prejevalsky, by Rockhill, Prince Henry of Orleans and Bonvalot, by Bower, Littledale, Welby, and Malcolm. From the results obtained by these explorers we have formed a fair idea of this, the most extensive, the highest, and

THE MOST INHOSPITABLE PLATEAU IN THE WORLD.

A few more lines run in well selected directions would probably supply geography with nearly all she wants to learn about such a region, though more minute exploration would probably furnish interesting details as to its geological history. The region lying to the north of the Himalayan range and to the south of the parallel of Lhasa is almost a blank on the map, and there is ample room here for the enterprising pioneer. The forbidden city of Lhasa is at present the goal of several adventurers, though, as a matter of fact, we cannot have much to learn in addition to what has been revealed in the interesting narrative of the native Indian traveler, Chandra Das. The magnificent mountain region on the north and east of Tibet furnishes a splendid field for the enterprising explorer. Mrs. Bishop recently approached it from the east, through Szechuen, and her description of the romantic scenery and the interesting non-Mongolian inhabitants leaves us with a strong desire to learn more. On the southeast of Tibet is the remarkable mountainous region, consisting of a series of lofty parallel chains, through which run the upper waters of the Yangtse, the Mekong, the

* For part of what follows with reference to Asia, I am indebted to a valuable memorandum on the subject drawn by the late Mr. Ney Elias.

Salwin, and the Irawady. This last named river, recent exploration has shown, probably does not reach far into the range. But it will be seen by a glance at a map that the upper waters of the other rivers are carried far into the heart of the mountains. But these upper river courses are entirely conjectural, and have given rise to much controversy. There is plenty of work here for the explorer, though the difficulties, physical and political, are great. But besides these great unexplored regions, there are many blanks to be filled up in other parts of Asia, and regions which, though known in a general way, would well repay careful examination. There is the mountain tract between the upper Zarafshan River and the middle course of the Sarkhab tributary of the Oxus, and the country lying between that and the Oxus. There is the great Takla-Makan Desert in Chinese or Eastern Turkistan, part of which has recently been explored by Russian expeditions, and by that young and indefatigable Swedish traveler, Dr. Sven Hedin. It is now one of the most forbidding deserts to be found anywhere; but it deserves careful examination, as there are evidences of its once having been inhabited, and that at no very remote period. It is almost surrounded by the Tarim, and on its eastern edge lies Lob-nor, the remarkable changes in which have been the subject of recent investigation. As readers of Dr. Nansen's "Voyage of the Fram" will remember, the Siberian coast is most imperfectly mapped; of course, it is a difficult task, but it is one to which the Russian government ought to be equal. China has on paper the appearance of being fairly well mapped; but, as a matter of fact, our knowledge of its mountain ranges and of its great river courses is, to a large extent, extremely vague. All this awaits careful survey. In Northeastern Manchuria and in many parts of Mongolia there are still blanks to be filled up, and mountain and river systems to be surveyed. In the Malay Peninsula, and in the great array of islands in the east and southeast of Asia—Sumatra, Borneo, the Philippines—much work still remains to be done. Thus, for the coming century, there will be abundance of work for explorers in Asia. Coming to

THE MAP OF AFRICA,

we find a marvelous transformation during the last sixty years, and mainly during the last forty years, dating from Livingstone's memorable journey across the continent. Though the north of Africa was the home of one of the oldest civilizations, and though on the shores of the Mediterranean Phenicians, Carthaginians, Greeks, and Romans were at work for centuries, it has only been within the memory of many of us that the center of the continent, from the Sahara to the confines of Cape Colony, has ceased to be an unexplored blank. This blank has been filled up with bewildering rapidity. Great rivers and lakes and mountains have been laid down in their main features, and the whole continent, with a few unimportant exceptions, has been parceled out among the powers of Europe. But much still remains to be done ere we can form an adequate conception of what is in some respects the most interesting and the most intractable of the continents. Many curious problems still remain to be solved. The pioneer work of exploration has to a large extent been accomplished; lines have been run in all directions; the main features have been blocked out. But between these lines the broad meshes remain to be filled in, and to do this will require many years of careful exploration. However, there still remain one or two regions that afford scope for the adventurous pioneer.

To the south of Abyssinia and to the west and northwest of Lake Rudolf, on to the Upper Nile, is a region of considerable extent, which is still practically unknown. Again, in the Western Sahara there is an extensive area, inhabited mainly by the intractable Tuaregs, into which no one has been able to penetrate, and of which our knowledge is extremely scanty. Even in the Central Sahara there are great areas which have not been traversed, while in the Libyan Desert much remains to be done. These regions are of interest almost solely from the geographical and geological standpoints. But they deserve careful investigation, not only that we may ascertain their actual present condition, but in order, also, that we may try to discover some clews to the past history of this interesting continent. Still, it must be said that the great features of the continent have been so fully mapped during the last half century that what is required now is mainly the filling in of the details. This is a process that requires many hands and special qualifications. All over the continent there are regions which will repay special investigation.

Quite recently an English traveler, Mr. Cowper, found not far from the Tripoli coast miles of magnificent ruins, and much to correct on our maps. If only the obstructiveness of the Turkish officials could be overcome, there is a rich harvest for anyone who will go to work with patience and intelligence. Even the interior of Morocco, and especially the Atlas Mountains, are but little known. The French, both in Tunis and Algeria, are extending our knowledge southward. All the powers who have taken part in the scramble for Africa are doing much to acquire a knowledge of their territories. Germany, especially, deserves praise for the persistent zeal with which she has carried out the exploration of her immense territories in East and West Africa. The men she sends out are unusually well qualified for the work, capable not simply of making a running survey as they proceed, and taking notes on country and people, but of rendering a substantial account of the geology, the fauna, the flora, and the economic conditions. Both in the French and the British spheres good work is also being done, and the map of Africa being gradually filled up. But what we especially want now are men of the type of Dr. J. W. Gregory, whose book on the Great Rift Valley is one of the most valuable contributions to African geography ever made.

If men of this stamp would settle down in regions like that of Mount Ruwenzori, or Lake Rudolf, or the regions about Lakes Bangweolo and Tanganyika, or in the Atlas, or in many other regions that could be named, the gains to scientific geography, as well as to the economical interests of Africa, would be great. An example of work of this kind is seen in the discoveries made by a young biologist trained in geographical observation—Mr. Moore, on Lake Tanganyika. There he found a fauna which seems to afford a key to the past history of the center of the continent, a fauna which, Mr. Moore maintains, is essentially of a soft water type. Mr. Moore, I believe, is inclined to maintain that the ancient connection of this part of Africa with the ocean was not by the west, as Joseph Thomson surmised, but by the north, through the Great Rift Valley of Dr. Gregory; and he strongly advocates the careful examination of Lake Rudolf as the crucial test of his theory. It is to be hoped that he, or some one equally competent, will have an opportunity of carrying out an investigation likely to provide results of the highest importance. I have dwelt thus long on Africa, because it will really be one of the great geographical problems of the coming century. Had it been as suitable as America or Australia, we may be sure it would not have remained so long neglected and despised by the European peoples as it has done. Unfortunately for Africa, just as it has been circumnavigated, and just as Europeans were beginning to settle upon its central portion and trying to make their way into the interior, Columbus and Cabot discovered

A NEW WORLD.

Probably nothing could be more marked than the progress which America has made since its rediscovery 400 years ago, and the stagnation of Africa which has been known to Europe since long before the beginning of history. During these 400 years North America at least has been very thoroughly explored. The two great nations which divide North America between them have their government surveys, which are rapidly mapping the whole continent and investigating its geology, physical geography and its natural resources. I need hardly tell an audience like this of the admirable work done by the survey of Canada under Sir William Logan, Dr. Selwyn, and his successor, Dr. George Dawson; nor should it be forgotten that under the Lands Department much excellent topographical work has been carried out by Captain Deville and his predecessors. Still, though much has been done, much remains to be done. There are large areas which have not as yet even been roughly mapped. Within quite recent years we have had new regions opened to us by the work of Dawson and Ogilvie on the Yukon, by Dr. Bell in the region to the south of Hudson's Bay, by the brothers Tyrrell in the Barren Lands on the west of the same bay, by O'Sullivan beyond the sources of the Ottawa, and by Low in Labrador. But it is not so long since that Dr. Dawson, in reviewing what remains to be done in the Dominion in the way of even pioneer exploration, pointed out that something like a million square miles still remained to be mapped. Apart from the uninhabitable regions of the north, there are, as Dr. Dawson pointed out, considerable areas which might be turned to profitable agricultural and mining account of which we know little, such areas as those which have been recently mapped on the south of Hudson's Bay by Dr. Bell, and beyond the Ottawa by Mr. O'Sullivan. Although the eastern and western provinces have been very fully surveyed, there is a considerable area between the two lying between Lake Superior and Hudson's Bay which seems to have been so far almost untouched. A very great deal has been done for the survey of the rivers and lakes of Canada. I need hardly say that in Canada, as elsewhere in America, there is ample scope for the study of many problems in physical geography—past and present glaciation and the work of glaciers, the origin and regime of lake basins, the erosion of river beds, the oscillation of coast lines.

Happily, both in Canada and the United States, there are many men competent and eager to work out problems of this class, and in the reports of the various surveys, the transactions of American learned societies, in scientific periodicals, in separate publications, a wealth of data has already been accumulated of immense value to the geographer. Every geologist and geographer knows the important work which has been accomplished by the various surveys of the United States, as well as by the various State surveys. The United States coast survey has been at work for more than half a century, mapping not only the coast, but all the navigable rivers. The lake survey has been doing a similar service for the shores of the great lakes of North America. But it is the work of the Geological Survey which is best known to geographers—a survey which is really topographical as well as geological, and which, under such men as Hayden, King and Powell, has produced a series of magnificent maps, diagrams and memoirs, of the highest scientific value and interest. Recently this survey has been placed on a more systematic basis; so that now a scheme for the topographical survey of the whole of the territory of the United States is being carried out. Extensive areas in various parts of the States have been already surveyed on different scales. It is to be hoped that in the future, as in the past, the able men who are employed on this survey work will have opportunities of working out the physiography of particular districts, the past and present geography of which is of advancing scientific interest. Of the complete exploration and mapping of the North American continent we need have no apprehension; it is only a question of time, and it is to be hoped that neither of the governments responsible will allow political exigencies to interfere with what is really a work of national importance. It is when we come to Central and South America that we find ample room for the unofficial explorer. [I am indebted for much of the information relative to South America to a valuable memorandum by Sir Clements R. Markham and Col. G. E. Church.] In Mexico and the Central American states there are considerable areas of which we have little or only the vaguest knowledge. In South America there is really more room now for the pioneer explorer than there is in Central Africa. In recent years the Argentine Republic has shown a laudable zeal in exploring and mapping its immense territories, while a certain amount of good work has also been done by Brazil and Chile. Most of our knowledge of South America is due to the enterprise of European and North American explorers.

Along the great river courses our knowledge is fairly satisfactory, but the immense areas, often densely clad with forests, lying between the rivers are almost entirely unknown. In Patagonia, though a good deal has lately been done by the Argentine government, still, in the country between Punta Arenas and the Rio Negro, we have much to learn; while on the west coast range, with its innumerable fjordlike inlets, its islands and peninsulas, there is a fine field for the geologist and physical geographer. Indeed, throughout the whole range of the Andes systematic exploration is wanted, exploration of the character of the excellent work accomplished by Whymper in the region around Chimborazo. There is an enormous area lying to the east of the Northern Andes, and including their eastern slopes, embracing the eastern half of Ecuador and Colombia, Southern Venezuela, and much of the country lying between that and Northern Bolivia, including many of the upper tributaries of the Amazon and Orinoco, of which our knowledge is of the scantiest. Even the country lying between the Rio Negro and the Atlantic is but little known. There are other great areas, in Brazil and in the Northern Chaco, which have only been partially described, such as the region whence the streams forming the Tapajos and the Paraguay take their rise, in Mato Grosso. A survey and detailed geographical and topographical description of the whole basin of Lake Titicaca is a desideratum. In short, in South America there is a wider and richer field for exploration than in any other continent. But no mere rush through these little-known regions will suffice. The explorer must be able not only to use his sextant and his theodolite, his compass and his chronometer. Any expeditions entering these regions ought to be able to bring back satisfactory information on the geology of the country traversed, and of its fauna and flora, past and present; already the revelations which have been made of the past

GEOGRAPHY OF SOUTH AMERICA

are of the highest interest. We have remains of extinct civilizations to deal with, and although much has been done in this direction, much remains to be done; and in the extensive region already referred to, the physique, the traditions, and the customs of the natives will repay careful investigation. The southern continent of Australia is in the hands of men of the same origin as those who have developed to such a wonderful extent the resources of Canada and the United States, and therefore we look for equally satisfactory results so far as the characteristics of that continent permit. The five colonies which divide among them the three million square miles of the continent have each of them efficient government surveys, which are rapidly mapping their features and investigating their geology. But Australia has a trying economic problem to solve. In none of the colonies is the water supply quite adequate; in all are stretches of desert country of greater or less extent. The center and western half of the continent is covered by a desert more waterless and more repellent than even the Sahara; so far as our present knowledge goes, one-third of the continent is uninhabitable. This desert area has been crossed by explorers, at the expense of great sufferings, in various directions, each with the same dreary tale of almost featureless sandy desert, covered here and there with spinifex and scrub, worse than useless. There are hundreds of thousands of square miles still unknown; but there is no reason to believe that these areas possess any features that differ essentially from those which have been found along the routes that have been explored. There have been one or two well-equipped scientific expeditions in recent years that have collected valuable data with regard to the physical characteristics, the geology and biology of the continent, and it is in this direction that geography should look for the richest results in the future. There remains much to be done before we can arrive at satisfactory conclusions as to the physical history of what is, in some respects, the most remarkable land area on the globe.

Though the surface water supply is so scanty, there is reason to believe that underneath the surface there is an immense store of water. In one or two places in Australia, especially in Western Queensland, and in New South Wales, this supply has been tapped with satisfactory results; millions of gallons a day have been obtained by sinking wells. Whether irrigation can ever be introduced on an extensive scale into Australia depends upon the extent and accessibility of the underground water supply, and that is one of the geographical problems of the future in Australia. New Zealand has been fairly well surveyed, though a good deal remains to be done before its magnificent mountain and glacier system is completely known. In the great island of New Guinea both the British and the Germans are opening the interiors of their territories to our knowledge, but the western and much larger portion of the island presents a large field for any explorer who cares to venture into its interior. The marvelous success which has attended Dr. Nansen's daring adventure into the Arctic seas has revived a widespread interest in

POLAR EXPLORATION.

Nansen has almost solved the North Polar problem. That some one will reach the Pole at no distant date is certain. Nansen has shown the way, and the legitimate curiosity of humanity will not rest satisfied till the goal be reached. But Arctic exploration does not end with the attainment of the Pole. Europe has done her share on her own side of the Pole; what about the side which forms the Hinterland of North America, and specially of Canada? To the north of Europe and Asia we have the scattered groups of islands Spitzbergen, Franz Josef Land, Novaya Zemlya and the New Siberian Islands. To the north of America we have an immense archipelago, the actual extent of which is unknown.

Nansen and other Arctic authorities maintain that the next thing to be done is to complete exploration on the American side—to attempt to do for that half of the North Polar region what Nansen has done for the other half. It may be that the islands which fringe the northern shores of the New World are continued far to the north; if so, they would form convenient stages for the work of a well-equipped expedition. It may be that they do not go much farther than we find them on our maps.

Whatever be the case, it is important, in the interest of science, that this section of the Polar area be examined; that as high a latitude as possible be attained; that soundings be made to discover whether the deep ocean extends all round the Pole. It is stated that the gallant Lieut. Peary has organized a scheme of exploring this area which would take several years to accomplish. Let us hope that he will be able to carry out his scheme. Meantime, should Canada look on with indif-

ference? She has attained the standing of a great and prosperous nation. She has shown the most commendable zeal in the exploration of her own immense territory. She has her educational, scientific, and literary institutions, which will compare favorably with those of other countries; her press is of a high order, and she has made the beginnings of a literature and an art of her own. In these respects she is walking in the steps of the mother country. But has Canada not reached a stage when she is in a position to follow the maternal example still further? What has more contributed to render the name of Great Britain illustrious than those great enterprises which for centuries she has sent out from her own shores, not a few of them solely in the interests of science? Such enterprises elevate a nation and form its glory and its pride. Surely Canada has ambitions beyond mere material prosperity, and what better beginning could be made than the equipment of an expedition for the exploration of the seas that lie between her and the Pole? I venture to throw out these suggestions for the consideration of those who have at heart the honor and glory of the great Canadian Dominion. Not only has an interest in Arctic exploration been revived, but in Europe at least an even greater interest has grown up in the exploration of the region around the opposite pole of the earth, of which our knowledge is so scanty.

Since Sir James C. Ross' expedition, which was sent out in the year 1839, almost nothing has been done for Antarctic research. We have here to deal with conditions different from those which surround the North Pole. Instead of an almost landless ocean, it is believed by those who have given special attention to the subject that a continent about the size of Australia covers the South Polar region. But we do not know for certain, and surely, in the interests of our science, it is time we had a fairly adequate idea of what are the real conditions. We want to know what is the extent of that land, what are its glacial conditions, what is the character of its geology, what evidence exists as to its physical and biological conditions in past ages? We know there is one lofty active volcano; are there any others? Moreover, the science of terrestrial magnetism is seriously impeded in its progress because the data in this department from the Antarctic are so scanty. The seas around this continent require to be investigated both as to their depth, their temperature, and their life. We have here, in short, the most extensive unexplored area on the surface of the globe. For the last three or four years the Royal Geographical Society, backed by other British societies, have been attempting to move the home government to equip an adequate expedition to complete the work begun by Ross sixty years ago, and to supplement the great work of the Challenger. But though sympathy has been expressed for Antarctic exploration, and though vague promises have been given of support, the government is afraid to enter upon an enterprise which might involve the services of a few naval officers and men. We need not criticise this attitude. But the Royal Geographical Society has determined not to let the matter rest here. It is now seeking to obtain the support of public-spirited men for an Antarctic expedition under its own auspices. It is felt that Antarctic exploration is peculiarly the work of England, and that if an expedition is undertaken, it will receive substantial support from the great Australasian colonies, which have so much to gain from a knowledge of the physical condition of a region lying at their own doors, and probably having a serious influence on their climatological conditions. Here, then, is one of the greatest geographical problems of the future, the solution of which should be entered upon without further delay. It may be mentioned that a small and well-equipped Belgian expedition has already started, mainly to carry out deep sea research around

THE SOUTH POLAR AREA.

But our science has to deal not only with the lands of the globe; its sphere is the whole of the surface of the earth, and all that is thereon, so far, at least, as distribution is concerned. The department of oceanography is a comparatively new creation; indeed, it may be said to have come definitely into being with the famous voyage of the Challenger. There had been expeditions for ocean investigation before that, but on a very limited scale. It has only been through the results obtained by the Challenger, supplemented by those of expeditions that have examined more limited areas, that we have been able to obtain an approximate conception of the conditions which prevail throughout the various ocean depths—conditions of movement, of temperature, of salinity, of life. We have only a general idea of the contours of the ocean bed, and of the composition of the sediment which covers that bed. The extent of the knowledge thus acquired may be gauged from the fact that it occupies a considerable space in the fifty quarto volumes—the "Challenger Publications," which it took Dr. John Murray twenty years to bring out. But that great undertaking has only, as it were, laid down the general features of the oceanic world. There is plenty of room for further research in this direction. Our own surveying ships, which are constantly at work all over the world, do a certain amount of oceanic work, apart from mere surveying of coasts, and islands, and shoals. In 1895 one of these found in the South Pacific soundings deeper by 300 fathoms than the deepest on record, that found twenty years earlier by the Tuscarora to the northeast of Japan. The deepest of these new soundings was 5,155 fathoms. In the interests of science, as well as of cable laying, it is desirable that our surveying ships should be encouraged to carry out work of this kind more systematically than they do at present. This could surely be arranged without interfering with their regular work. We want many more observations than we now have, not only on ocean depths, but on the nature of the ocean bed, before we can have a satisfactory map of this hidden portion of the earth's surface, and form satisfactory conclusions as to the past relations of the ocean bed with what is now dry land. I believe the position maintained by geologists, that from the remote period when the great folds of the earth were formed, the present relations between the great land masses and the great oceans have been essentially the same; that there have no doubt been great changes, but that these have been within such limits as not to materially affect their relations as a whole. This is a problem which further oceanic research would go a long way to elucidate. That striking changes are going on at the present day, and have been going on within the human period, cannot be doubted. Some coast lines are rising; others are falling. Prof. John Milne, our great authority on seismology, has collected an extremely interesting series of data as to the curious changes that have taken place in the ocean bed since telegraphic cables have been laid down. The frequent breakages of cables have led to the examination of the suboceanic ground on which they have been laid, and it is found that slides and sinkings have occurred, in some cases amounting to hundreds of fathoms. These, it is important to note, are on the slopes of the continental margin, or, as it is called, the continental shelf, as, for example, off the coast of Chile. It is there, where the earth's crust is peculiarly in a state of unstable equilibrium, that we might expect to find such movements; and, therefore, soundings along the continental margins, at intervals of, say, five years, might furnish science with data that might be turned to good account. Another important problem to attack, and that in the near future, is that of oceanic islands. I say in the near future, because it is to be feared that very few islands now remain unmodified by contact with Europeans. Not only have the natives been affected, both in physique and in customs, but the introduction of European plants and animals has to a greater or less extent modified the native fauna and flora. Dr. John Murray, of the Challenger, has set a good example in this direction by sending a young official from the Natural History Museum to Christmas Island, in the Indian Ocean, one of the few untouched islands that remain, lying far away from any other land, to the southeast of the Keelings. What islands are to the ocean, lakes are to the land. It is only recently that these interesting geographical features have received the attention they deserve. Rivers are of not less geographical interest than lakes, and these have also recently been the subject of special investigation by physical geographers. But time does not admit of my going farther. I might have pointed out the wide and vastly interesting field presented by what the Germans call anthropogeography, dealing with the interrelations between humanity and its geographical environment. Geography, Mr. Mackinder has said, is the physical basis of history; it is, indeed, the physical basis of all human activity, and from that standpoint the field for geographical research is unbounded. But I can only hint at this. I have endeavored to indicate what are some of the leading geographical problems of the future, first in order to show at this somewhat critical epoch how very much yet remains to be done, how many important lines of inquiry are open to the geographical student.

[Continued from Supplement, No. 1132, page [illegible].]

ADDRESS BY SIR JOHN EVANS,

K.C.B., D.C.L., LL.D., Sc.D., Treas. R.S., V.P.S.A., For. Sec. G. S.; Correspondant de l'Institut de France, etc.; President of the British Association for the Advancement of Science.*

It must, moreover, be remembered that in what are probably the earliest of the palæolithic deposits of the eastern counties, those at the highest level, near Brandon, in Norfolk, where the gravels contain the largest proportion of pebbles derived from glacial beds, some of the implements themselves have been manufactured from materials not native to the spot but brought from a distance, and derived in all probability either from the bowlder clay or from some of the beds associated with it.

We must, however, take a wider view of the whole question, for it must not for a moment be supposed that there are the slightest grounds for believing that the civilization, such as it was, of the palæolithic period originated in the British Isles. We find in other countries implements so identical in form and character with British specimens that they might have been manufactured by the same hands. These occur over large areas in France under similar conditions to those that prevail in England. The same forms have been discovered in the ancient river gravels of Italy, Spain, and Portugal. Some few have been recorded from the north of Africa, and analogous types occur in considerable numbers in the south of that continent. On the banks of the Nile, many hundreds of feet above its present level, implements of the European types have been discovered; while in Somaliland, in an ancient river valley at a great elevation above the sea, Mr. Seton-Karr has collected a large number of implements formed of flint and quartzite, which, judging from their form and character, might have been dug out of the drift deposits of the Somme or the Seine, the Thames or the ancient Solent.

In the valley of the Euphrates implements of the same kind have also been found, and again farther east in the lateritic deposits of southern India they have been obtained in considerable numbers. It is not a little remarkable, and is at the same time highly suggestive, that a form of implement almost peculiar to Madras reappears among implements from the very ancient gravels of the manzanares at Madrid. In the case of the African discoveries we have as yet no definite palæontological evidence by which to fix their antiquity, but in the Narbadá valley of western India palæolithic implements of quartzite seem to be associated with a local fauna of Pleistocene age, comprising, like that of Europe, the elephant, hippopotamus, ox, and other mammals of species now extinct. A correlation of the two faunas with a view of ascertaining their chronological relations is beset with many difficulties, but there seems reason for accepting this Indian Pleistocene fauna as in some degree more ancient than the European.

Is this not a case in which the imagination may be fairly invoked in aid of science? May we not from these data attempt in some degree to build up and reconstruct the early history of the human family? There, in eastern Asia, in a tropical climate, with the means of subsistence readily at hand, may we not picture to ourselves our earliest ancestors gradually developing from a lowly origin, acquiring a taste for hunting, if not indeed being driven to protect themselves from the beasts around them, and evolving the more complicated forms of tools or weapons from the simpler flakes which had previously served them as knives? May we not imagine that, when once the stage of civilization denoted by these palæolithic implements had been reached, the game for the hunter became scarcer, and that his life in consequence assumed a more nomad character? Then, and possibly not till then, may a series of migrations to "fresh woods and pastures new" not unnaturally have ensued, and these following the usual course of "westward toward the setting sun," might eventually lead to a palæolithic population finding its way to the extreme borders of western Europe, where we find such numerous traces of its presence.

How long a term of years may be involved in such a migration it is impossible to say, but that such a migration took place the phenomena seem to justify us in believing. It can hardly be supposed that the process that I have shadowed forth was reversed, and that man, having originated in northwestern Europe, in a cold climate where clothing was necessary and food scarce, subsequently migrated eastward to India and southward to the Cape of Good Hope! As yet, our records of discoveries in India and Eastern Asia are but scanty; but it is there that the traces of the cradle of the human race are, in my opinion, to be sought, and possibly future discoveries may place upon a more solid foundation the visionary structure that I have ventured to erect.

It may be thought that my hypothesis does not do justice to what Sir Thomas Browne has so happily termed "that great antiquity, America." I am, however, not here immediately concerned with the important neolithic remains of all kinds with which this great continent abounds. I am now confining myself to the question of palæolithic man and his origin, and in considering it I am not unmindful of the Trenton implements, though I must content myself by saying that the "turtleback" form is essentially different from the majority of those on the wide dissemination of which I have been speculating, and, moreover, as many here present are aware, the circumstances of the finding of these American implements are still under discussion.

Leaving them out of the question for the present, it may be thought worth while to carry our speculations rather further, and to consider the relations in time between the palæolithic and the neolithic periods. We have seen that the stage in human civilization denoted by the use of the ordinary forms of palæolithic implements must have extended over a vast period of time if we have to allow for the migration of the primeval hunters from their original home, wherever it may have been in Asia or Africa, to the west of Europe, including Britain. We have seen that, during this migration, the forms of the weapons and tools made from silicious stones had become, as it were, stereotyped, and further that, during the subsequent extended period implied by the erosion of the valleys, the modifications in the form of the implements and the changes in the fauna associated with the men who used them were but slight.

At the close of the period during which the valleys were being eroded comes that represented by the latest occupation of the caves by palæolithic man, when both in Britain and in the south of France the reindeer was abundant; but among the stone weapons and implements of that long troglodytic phase of man's history not a single example with the edge sharpened by grinding has as yet been found. All that can safely be said is that the larger implements as well as the larger mammals had become scarcer, that greater power in chipping flint had been attained, that the art of the engraver and the sculptor had considerably developed, and that the use of the bow had probably been discovered.

Directly we encounter the relics of the neolithic period, often, in the case of the caves lately mentioned, separated from the earlier remains by a thick layer of underlying stalagmite, we find flint hatchets polished at the edge and on the surface, cutting at the broad and not at the narrow end, and other forms of implements associated with a fauna in all essential respects identical with that of the present day.

Were the makers of these polished weapons the direct descendants of palæolithic ancestors whose occupation of the country was continuous from the days of the old river gravels? or had these long since died out, so that after western Europe had for ages remained uninhabited, it was repeopled in neolithic times by the immigration of some new race of men? Was there in fact a "great gulf fixed" between the two occupations? or was there in Europe a gradual transition from the one stage of culture to the other?

It has been said that "what song the Sirens sang, or what name Achilles assumed when he hid himself among women, though puzzling questions, are not beyond all conjecture;" and though the questions now proposed may come under the same category, and must await the discovery of many more essential facts before they receive definite and satisfactory answers, we may, I think, throw some light upon them if we venture to take a few steps upon the seductive, if insecure, paths of conjecture. So far as I know, we have as yet no trustworthy evidence of any transition from the one age to the other, and the gulf between them remains practically unbridged. We can, indeed, hardly name the part of the world in which to seek for the cradle of neolithic civilization, though we know that traces of what appear to have been a stone-using people have been discovered in Egypt, and that what must be among the latest of the relics of their industry have been assigned to a date some 3,500 to 4,000 years before our era. The men of that time had attained to the highest degree of skill in working flint that has ever been reached. Their beautifully made knives and spearheads seem indicative of a culminating point reached after long ages of experience; but whence these artists in flint came or who they were is at present absolutely unknown, and their handiworks afford no clew to help us in tracing their origin.

Taking a wider survey, we may say that, generally speaking, not only the fauna but the surface configuration of the country were, in western Europe at all events, much the same at the commencement of the neolithic period as they are at the present day. We have, too, no geological indications to aid us in forming any chronological scale.

The occupation of some of the caves in the south of France seems to have been carried on after the erosion of the neighboring river valleys had ceased, and so far as our knowledge goes these caves offer evidence of being the latest in time of those occupied by man during the palæolithic period. It seems barely possible that though in the north of Europe there are no distinct signs of such late occupation, yet that, in the south,

* Delivered at Toronto, August 18, 1897.

man may have lived on, though in diminished numbers; and that in some of the caves, such, for instance, as those in the neighborhood of Mentone, there may be traces of his existence during the transitional period that connects the paleolithic and neolithic ages. If this were really the case, we might expect to find some traces of a dissemination of neolithic culture from a north Italian center, but I much doubt whether any such traces actually exist.

If it had been in that part of the world that the transition took place, how are we to account for the abundance of polished stone hatchets found in Central India? Did neolithic man return eastward by the same route as that by which in remote ages his paleolithic predecessor had migrated westward? Would it not be in defiance of all probability to answer such a question in the affirmative? We have, it must be confessed, nothing of a substantial character to guide us in these speculations; but, pending the advent of evidence to the contrary, we may, I think, provisionally adopt the view that, owing to failure of food, climatal changes, or other causes, the occupation of western Europe by paleolithic man absolutely ceased, and that it was not until after an interval of long duration that Europe was repeopled by a race of men immigrating from some other part of the globe where the human race had survived, and in course of ages had developed a higher stage of culture than that of paleolithic man.

I have been carried away by the liberty allowed for conjecture into the regions of pure imagination, and must now return to the realms of fact, and one fact on which I desire for a short time to insist is that of the existence at the present day, in close juxtaposition with our own civilization, of races of men who, at all events but a few generations ago, lived under much the same conditions as did our own neolithic predecessors in Europe.

The manners and customs of these primitive tribes and peoples are changing day by day, their languages are becoming obsolete, their myths and traditions are dying out, their ancient processes of manufacture are falling into oblivion, and their numbers are rapidly diminishing, so that it seems inevitable that ere long many of these interesting populations will become absolutely extinct. The admirable Bureau of Ethnology instituted by our neighbors in the United States of America has done much toward preserving a knowledge of the various native races in this vast continent; and here in Canada the annual Archeological Reports presented to the minister of education are rendering good service in the same cause.

Moreover, the committee of this association appointed to investigate the physical characters, languages, and industrial and social conditions of the northwestern tribes of the Dominion of Canada is about to present its twelfth and final report, which, in conjunction with those already presented, will do much toward preserving a knowledge of the habits and languages of those tribes. It is sad to think that Mr. Horatio Hale, whose comprehensive grasp of the bearings of ethnological questions, and whose unremitting labors have so materially conduced to the success of the committee, should be no longer among us. Although this report is said to be final, it is to be hoped that the committee may be able to indicate lines upon which future work in the direction of ethnological and archeological research may be profitably carried on in this part of Her Majesty's dominions.

It is, however, lamentable to notice how little is being or has been officially done toward preserving a full record of the habits, beliefs, arts, myths, languages and physical characteristics of the countless other tribes and nations more or less uncivilized which are comprised within the limits of the British Empire. At the meeting of this association held last year at Liverpool it was resolved by the general committee "that it is of urgent importance to press upon the government the necessity of establishing a bureau of ethnology for Greater Britain, which, by collecting information with regard to the native races within and on the borders of the empire, will prove of immense value to science and to the government itself." It has been suggested that such a bureau might, with the greatest advantage and with the least outlay and permanent expense, be connected either with the British Museum or with the Imperial Institute, and the project has already been submitted for the consideration of the trustees of the former establishment.

The existence of an almost unrivaled ethnological collection in the museum, and the presence there of officers already well versed in ethnological research, seem to afford an argument in favor of the proposed bureau being connected with it. On the other hand, the Imperial Institute was founded with an especial view to its being a center around which every interest connected with the dependencies of the empire might gather for information and support. The establishment within the last twelve months of a scientific department within the institute, with well appointed laboratories and a highly trained staff, shows how ready are those concerned in its management to undertake any duties that may conduce to the welfare of the outlying parts of the British Empire; a fact of which I believe that Canada is fully aware. The institute is therefore likely to develop, so far as its scientific department is concerned, into a bureau of advice in all matters scientific and technical, and certainly a bureau of ethnology such as that suggested would not be out of place within its walls.

Wherever such an institution is to be established, the question of its existence must of necessity rest with Her Majesty's government and treasury, inasmuch as without funds, however moderate, the undertaking cannot be carried on. I trust that in considering the question it will always be borne in mind that in the relations between civilized and uncivilized nations and races it is of the first importance that the prejudices and especially the religious or semireligious and caste prejudices of the latter should be thoroughly well known to the former. If but a single "little war" could be avoided in consequence of the knowledge acquired and stored up by the Bureau of Ethnology preventing such a misunderstanding as might culminate in warfare, the cost of such an institution would quickly be saved.

I fear that it will be thought that I have dwelt too long on primeval man and his modern representatives, and that I should have taken this opportunity to discuss some more general subject, such as the advances made in the various departments of science since last this association met in Canada. Such a subject would no doubt have afforded an infinity of interesting topics on which to dilate. Spectrum analysis, the origin and nature of celestial bodies, photography, the connection between heat, light, and electricity, the practical applications of this latter, terrestrial magnetism, the liquefaction and solidification of gases, the behavior of elements and compounds under the influence of extreme cold, the nature and uses of the Roentgen rays, the advances in bacteriology and in prophylactic medicine, might all have been passed under review, and to many of my audience would have seemed to possess greater claims to attention than the subject that I have chosen.

It must, however, be borne in mind that most, if not indeed all, of these topics will be discussed by more competent authorities in the various sections of the association by means of the presidential addresses or otherwise. Nor must it be forgotten that I occupy this position as a representative of archeology, and am therefore justified in bringing before you a subject in which every member of every race of mankind ought to be interested—the antiquity of the human family and the scenes of its infancy.

Others will direct our thoughts in other directions, but the farther we proceed the more clearly shall we realize the connection and interdependence of all departments of science. Year after year, as meetings of this association take place, we may also foresee that "many shall run to and fro and knowledge shall be increased." Year after year advances will be made in science, and in reading that book of nature that lies ever open before our eyes, successive stones will be brought for building up that temple of knowledge of which our fathers and we have labored to lay the foundations. May we not well exclaim with old Robert Recorde?

"Oh woorthy temple of Goddes magnificence: Oh throne of glorye and seate of the lorde: thy substance most pure what tonge can describe? thy signes are so wonderous, surmountinge mannes witte, the effects of thy motions so divers in kinde: so harde for to searche, and worse for to fynde—Thy woorkes are all wonderous, thy cunning unknowen: yet seedes of all knowledge in that booke are sowen—And yet in that boke who rightly can reade, to all secrete knowledge it will him straighte leade."*

PROF. MAYER.

ALFRED MARSHALL MAYER.†

A MAN of science, whose work was unique in the domain which he had selected, and who will long be held in warm remembrance by a large circle of friends, has lately passed away.

In 1784 there emigrated to America a young German, Christian Mayer, a member of an ancient family in the city of Ulm, in Württemberg. He made his home in Baltimore, where, by strong intelligence and well directed industry, he amassed a fortune. To his two sons, Charles F. and Brantz, he gave the best educational advantages of the day. The former became a prominent lawyer, well known in the best social circles of Baltimore on account of his refinement and broad literary culture, while the latter traveled and wrote extensively, his historical work, especially in connection with Mexico, being of high authority and acknowledged value.

On the 13th day of November, 1836, a son was born to Charles F. Mayer. At an early age the boy exhibited great mechanical ingenuity and a lively interest in the external world of nature. At St. Mary's College, in Baltimore, he was afforded all the usual facilities for an elementary liberal education, and especially for classical training; but this did not suit his native bent. At the age of sixteen years he gave up the school room, and the following two years were spent chiefly in the workshop and the draughting room of a mechanical engineer. Here was abundant opportunity for acquiring familiarity with the use of tools and developing manipulative skill. At the same time there was a continual stimulus to private study in connection with the daily application of the laws of physics and mechanics. This course of study in applied science was a natural precursor to the resumption of more systematic work, not in the class room, but in the laboratory. A course of chemistry was undertaken, and two years were spent largely in mastering the principles and processes of quantitative analysis. It was during these years of private study and practical work that young Mayer attracted the attention of a man whose personal influence was chiefly instrumental in determining the future direction of the student's energies. Joseph Henry was at this time secretary of the Smithsonian Institution, and for thirty years he had been identified with the advancement of pure science in America. Industrial science needs no advocates. Its importance is recognized by all. Its immediate connection with material progress and its quick response to commercial demands are sufficient to bring within the ranks of its devotees the great majority of those who undertake laboratory work with a definite purpose. Henry had never underrated the value or the need of industrial science, but he had emphasized the importance of investigation from the more unselfish standpoint of one who regarded intellectual acquisition as a priceless good in itself apart from all commercial recompense. He apprehended the brightness, the alertness, the originality of the Baltimore student, and accorded him that sympathetic recognition which constitutes the greatest stimulus that a young man can receive. The friendship of an acknowledged master makes a willing and easily directed pupil. Ideals of excellence are thus formed for life. Subsequent experience may sometimes modify these, but they are rarely ever discarded.

At the early age of twenty years Mayer was appointed to the chair of physics and chemistry in the University of Maryland. He had already, during the previous year, published his first contribution to science, the description of a "new apparatus for the determination of carbonic acid." This was soon republished in Germany.

His new duties absorbed now most of his time, but a second paper appeared in the American Journal of Science, in 1857, on the estimation of the weights of very small portions of matter. In this he showed that by the deflection of a fine glass fiber it is possible to estimate a variation in weight so small as the thousandth

* Preface to Robert Recorde's Castle of Knowledge, 1556.

† By Prof W. Le Conte Stevens, in Science. Prof. Stevens is particularly well adapted to write of his friend, owing to their mutual love for acoustics, in which branch of physics they have both done notable work. Prof. Mayer will be specially remembered by readers of the SCIENTIFIC AMERICAN SUPPLEMENT, by reason of his articles in 1877-1878 on "The Minute Measurements of Modern Science." The following is a synopsis of these articles, with the numbers of the papers: I, Size of the magnitudes to be measured, 56; II, Micrometer screw, 56; III, Measuring by means of micrometer screw with contact level, 60; IV, Spherometer, 62; V, Micrometer microscope, 64; VI, Compound microscope applied to minute measurements, 67; VII, Vernier and vernier microscope, 72; VIII, Cathetometer, 77; IX, Dividing engine, 80; X, Construction of a perfect screw, 92; XI, Rotating mirrors applied to the measurement of minute lengths, Saxton's comparator, 98; XII, XIII, XIV, Saxton's comparator, 100, 103, 107; XV, Horizontal pendulum, 112; XVI, Use of tuning fork, 161; XVII, Wheatstone's experiments to measure velocity of electricity, 165; XVIII, XIX, On nature and duration of electric discharge; Feddersen, Henry, Rood and Mayer's experiments, 166, 175; XX, Measurement of light waves, 177.

part of a milligramme. In 1859 he accepted a chair in Westminster College, Missouri, where two years were spent; but the equipment of this institution was insignificant and no original work was accomplished. The breaking out of the civil war determined his return to Baltimore, and in 1863 he went to Paris, where two years were occupied in special study, chiefly under the direction of Regnault. The influence of the great French physicist, and the general atmosphere of the University of Paris, strengthened the bias in favor of pure science which had been received in youth from Henry.

Soon after his return to America, in 1865, Prof. Mayer was called to the chair of physics and chemistry at Pennsylvania College, in Gettysburg, which he gave up in 1867 to accept that of physics and astronomy in Lehigh University. This in turn was renounced in 1871 for the purpose of joining in the upbuilding of the new Stevens Institute of Technology, at Hoboken, with which his connection continued up to the time of his death, July 13, 1897. It is with this institution, therefore, that his name will always be chiefly identified, though his researches were for the most part in channels somewhat removed from those that are usually characteristic of an engineering school. Its instrumental equipment was unusually good, and proximity to a great metropolis afforded the intellectual stimulus and the prompt recognition of merit which are wanting in isolated institutions of learning.

While connected with Lehigh University Prof. Mayer designed an astronomical observatory and superintended its construction. He erected the instruments and, without assistance, finished the tedious work of adjusting them. A series of observations on Jupiter followed, and its publication was reproduced in England. During the summer vacation of 1869 he was deputed by the United States government to take charge of a party of astronomers at Burlington, Iowa, where the solar eclipse of August 7 was observed. During the eclipse more than forty successful photographs were taken, each exposure lasting 0·002 second. Four of these were during the eighty-three seconds of totality. This was in the early days of instantaneous photography and was accounted an unusual feat. An abstract of the results of measurements on these photographs was published in the Journal of the Franklin Institute. In the same journal, about this time, he published a number of articles on physical and astrophysical subjects. At the Salem meeting of the Scientific Association, 1869, a paper was read "On the Thermodynamics of Waterfalls." At Trenton Falls and at Niagara Falls careful observations had been made on the temperature of the water at the top of the cataract and just beyond the point of impact at the bottom. The arrest of motion develops heat, and this was found to be manifested in a measurable rise of temperature, when the air was charged with moisture and not much warmer or colder than the water, the change being in accordance with calculation based on Joule's equivalent. But under other conditions this effect was masked to such an extent by the cooling effect of evaporation and conduction that there was sometimes a lower temperature at the bottom than at the top.

Soon after entering upon his duties at Hoboken, Prof. Mayer began the series of investigations in acoustics for which he is, perhaps, best known, and which made him decidedly the leading authority on this subject in America. In the first of his papers he showed how the co-vibration of two nearly unisonant tuning forks may be utilized to demonstrate Doppler's well known principle that wave length may be modified by translation of the vibrating body. This was soon followed by another paper in which he gave a method of detecting the phases of vibration in the air surrounding a sounding body. Two resonators responding to the pitch of the source were employed, each connected with a manometric capsule. One of these resonators being fixed and the other movable, the recurring changes in the compound flame image gave the means of measuring wave length directly in the vibrating air and exploring the form of the wave surface. A simple and precise method was developed from this for measuring wave lengths and velocities of sound in gases at various temperatures; and an acoustic pyrometer was devised by which furnace temperatures were capable of measurement with a degree of accuracy approaching that of the air thermometer. The same optical method of interference was then further applied to the determination of the relative intensities of sounds. The range of application of this method is somewhat limited, but within this range it is more precise than any other method devised for the same purpose. One application was to the measurement of the powers of various substances to transmit and to reflect sonorous vibrations. An investigation of the relative absorbing powers of different media for sound led to an approximate determination of the mechanical equivalent of an aërial sonorous vibration. The energy per second given forth in aërial vibrations by an Ut$_3$ fork (256 vd.), set in motion by intermittent electro-magnetic action and placed before an appropriate resonator, was found to be about one millionth of Joule's unit, or enough to raise one gramme through a height of ten centimeters. This result was accomplished by measuring the relative intensities of the sound given forth by the same fork, first when vibrating freely, then when the motion of its prongs was damped by the expenditure of part of its energy on India rubber. The rise of temperature of the rubber was measured by use of thermopile and galvanometer, and its specific heat determined by ordinary methods. The difficulties attendant upon such an experiment are very great, and no one but an experimentalist of exceptional skill and patience would be apt to undertake it.

These strictly physical investigations led Prof. Mayer into the domain of physiology in its bearing upon the phenomena of audition. The most important principle in acoustics is that of harmonic motion, simple and compound, as embodied in Fourier's theorem. Helmholtz was the first to apply this to the analysis of musical quality, and in doing so the subjective method of resonators was utilized with great skill. Prof. Mayer sought objective methods and devised several of these, the most striking of which was that of employing tense threads as media for the conveyance of energy from a vibrating membrane to mounted tuning forks adjusted in pitch to respond to the components of the compound sound under examination. Recognizing the capacity of the ear, when sufficiently trained, to accomplish this analysis to a considerable extent without instrumental aid, he sought to learn the mechanism of the auditory apparatus of some of the lower types of animal life. Some new and interesting facts were thus discovered in relation to the function of the antennæ of the mosquito in audition, and he showed how an insect may determine the direction of sounds by means of its antennæ. In this connection good reason was found for the belief that the terminal auditory nerve fibrils in the human ear vibrate just half as often in a given time as the membrane of the tympanum and the ossicles. This hypothesis partially accounts for the marked difference in quality when the same sound is successively heard, first directly through the open ear and then through the medium of the bony portions of the head.

Prof. Mayer's most important acoustic research was his determination of the law connecting the pitch of a sound with the duration of the residual sensation in the ear. An explanation of the method adopted cannot be here given without entering unduly into details. This law gave a quantitative character to results which Helmholtz had attained only qualitatively. It is of fundamental importance in its application to musical harmony. It explains why certain combinations of tones which are harmonious in the upper portions of the musical scale become rough and discordant in the lower portions. This mere fact the musical composer was long compelled to recognize, though hitherto it had been inexplicable. The labor involved in this work was great, and before its completion the investigator's power of audition in one ear was thereby permanently impaired. The first experiments were published in 1874; a redetermination was made in 1875, and again with improved apparatus in 1893. He received the assistance of the most accomplished musical experts, including Madame Seiler, who had been associated with Helmholtz for a somewhat similar purpose, and Dr. Rudolph Koenig, of Paris, whose training in the detection of musical beats is unrivaled. Dr. Koenig, in 1893, rendered important service in ascertaining the limitations of what may now be properly called "Mayer's Law." This law is expressed by an equation in which the duration of the residual sensation is given as a function of vibration frequency, and this equation is readily translated into a curve. Between the limits of 100 and 4,000 vibrations per second there is closer accordance between the results of calculation and observation than in the case of Fechner's law, or indeed any other physiological law for which the attempt has been made to express sensation mathematically. Between 200 and 2,000 vibrations, including the range most constantly resorted to in music, the accordance is satisfactory, even when measured by physical rather than physiological standards. Due recognition of these important contributions to acoustic theory have been made by Mr. Ellis in his translation of Helmholtz's "Tonempfindungen" and by Prof. Zahm in his recent book (1892) on "Sound and Music." Mr. Ellis gave a special lecture in London for the purpose of explaining these discoveries and their application to the principles of musical harmony.

It was natural for Prof. Mayer to apply acoustic methods in work primarily undertaken for other purposes. In 1876 he devised improvements in what is now generally known as the electrographic method for the measurement of the velocity of projectiles and the determination of pitch. He utilized the spark from an induction coil for the purpose of marking seconds upon the sinuous trace of a tuning fork on smoked paper, and attained results of great accuracy. He studied with care the laws of vibration of tuning forks, and was the first to give accurately the correction to be applied in all such determinations on account of variation in temperature of the fork. Between 1889 and 1894 he conducted an elaborate research on the variation of the modulus of elasticity of various materials with change of temperature, as indicated by the transverse vibration of bars. From the observed pitch the velocity of propagation of sound in the bar is found, and this gives the modulus of elasticity. For the accurate determination of pitch it was necessary to visit Paris, where access was had to Dr. Koenig's grand tonometer, and where this accomplished acoustician freely gave his time and skill in furtherance of the work. The remarkable regularity in the results shows that this acoustic method, as conducted, is worthy of the greatest reliance. Among the materials thus studied was aluminum. Its modulus was found to be subject to large variation, and in every respect it is far inferior to steel for acoustic purposes.

(To be continued.)

ROSA WICHURAIANA.

THERE are very few of the wild types of Rosa whose flowering time comes so late in the year as the end of July and the beginning of August, but of those few R. Wichuraiana is one. It is of very recent introduction, but the distinct character of its growth and the late date at which it blossoms have already obtained for it considerable notice in this country, although not so much as in the United States, where it is already a popular shrub. It is a native of Japan, and reached this country by the way of the United States about five or six years ago. The two characters which more than any others distinguish this rose are its procumbent habit and the very lustrous dark green color of its leaves, these being, indeed, so bright on both sides

ROSA WICHURAIANA, HARDY ROSE—FLOWERS WHITE.

as to suggest their being coated with varnish. Each one consists of five, seven or nine leaflets, which are oblong or elliptical, serrated, and from ½ to 1 inch long. The petiole bears a few short spines and bristles, and the stipules have their margins set with glandular teeth. On the strong, succulent, non-flowering shoots of the current year the wood is armed with stout curved spines, but on the thinner flowering shoots of the following year they are mostly arranged in pairs just beneath each node. The flowers are of the purest white, and the clusters appear just above the dense carpet of glossy leaves, which completely covers the soil. Each flower is upward of two inches in diameter, the petals (normally five) often numbering six or seven under cultivation. This species should be given a rich soil, and, what is of equal or greater importance, the sunniest possible position. It is, no doubt, the intense and prolonged sunshine it receives in North America that causes it to flower so abundantly there. It is a plant of vigorous and luxuriant growth, and can be increased with the greatest ease by means of cuttings put in during the next two or three weeks.—The Gardeners' Chronicle.

A kerosene incandescent burner is made which will fit on an ordinary kerosene lamp. The kerosene is drawn up into a small chamber by a number of wicks, and is there vaporized by a small external flame. After two and one-half minutes the heat in this little chamber is sufficient to supply the vapor for a flame which raises the mantle to white heat. The mantle is similar to that used with a coal gas flame. A great drawback about this burner is that two and one-half minutes must elapse after the first application of light till the lamp is ready for use. A similar burner is made to use with a methylated spirits flame.—Uhland's Wochenschrift.

ENGINEERING NOTES.

Paris (France) is to be supplied with well water from the departments of the Eure and Loire, some 490 ft. above the level of Paris and over 100 miles away.—Zeitschrift für Architectur.

Cork paving has been tested in England, and is found to be very noiseless, elastic and waterproof. It gives a good hold to the feet, is never slippery, and withstands the action of the weather very well. The wear due to friction is also very small.—Monatschrift für den Oeffentlichen Baudienst.

A plan for connecting South and West Australia by railroad is under consideration. The distance between the ends of their railroad systems is only 553 miles, but the country to be traversed is an arid desert, and reservoirs must be built at twenty-five mile intervals along the whole line. The cost will be about $10,000,000.

The strongest steel ropes ever made are probably the two recently finished, says Uhland's Wochenschrift, by Messrs. Felten and Guilleaume, Mülheim, Germany, for a bridge over the Argen River, near the Boden Lake. These ropes are made of 259 wires, each about a quarter of an inch thick. They weigh some 135 lb. per yard, and their strength is such that it would require a force of 1,800,000 lb. weight to tear them. The bridge for which they are made will be 102 ft. long.

The Theatre Francais, at Paris, has a peculiar device to insure the greatest possible safety for the audience. Not only can the scene be separated from the audience by a hermetically closing steel curtain, but the roof of the scene can be uncovered at a moment's notice, so that a draught of air is produced which carries away the smoke and noxious gases produced in the fire. These, it is said, constitute the greatest danger to the audience, often rendering escape quite impossible. It is on the scene that the fire usually breaks out.—Monatschrift für den Oeffentlichen Baudienst.

Very few know it, but it is a fact, says the Washington Star, that the Pension Office Building is the largest brick building in the world. It has been subjected to much criticism, but it can stand it, for as time passes along there are many things seen about it that escaped notice when it was newer. In all there are over 10,000,000 bricks in the building. General Meigs took liberties with bricks that no other architect had ever attempted. He not only used bricks exclusively for the building, but he used them in constructing the stairs throughout the building. In the matter of stair building bricks have often been used for the riser, but the step has always been of iron, wood, slate or stone. In the Pension Office both riser and step are of brick. As a brick building, therefore, pure and simple, it is unique in construction, outside of the fact that it is the largest exclusively brick building in the world.

Some curious effects of the tests of the new magazine rifles in actual service are noted in Engineering. Cordite was accused of causing rapid wear of the rifling, and this charge must have had some foundation, as the Metford rifling has been abandoned in the weapons now issued, and has been replaced by the system devised by Rigby, which is said to wear well and give more accurate shooting than the Mannlicher, Mauser or Lebel systems. Certainly the wear cannot now be a very serious matter, if the reports can be relied on that accurate shooting has been made even after firing some thousands of rounds and the weapon is still serviceable after 8,000 or 9,000 rounds have been fired. In the Tochi punitive expedition the new Dumdum bullet will be employed, that originally used having proved deficient in stopping power. In the Chitral campaign one man was six times shot, and nevertheless he recovered. The private soldiers are, accordingly, losing confidence in the weapon.

The Railroad Gazette says: "The people of George Stephenson's race have not kept railroads to themselves, but so far they have a long lead of the rest of the world in constructing them. There is not much room in Great Britain for a great mileage, and in Europe, of the total 155,284 miles, only 20,977 miles are on British territory. But of the 26,890 miles in Asia, 19,700 miles are on such territory; in Africa, 2,845 miles out of 8,169; in America, of the 48,005 miles outside of the United States, 16,719 miles are British, and of course, all the 13,888 miles in Australia. Altogether, there are 74,129 miles of railroad in the British possessions, which added to the 181,717 miles in the United States (all the figures are for 1895), makes the considerable figure of 255,846 miles, which is nearly three-fifths of the railroads of the world. And this takes no account of 7,127 miles of Mexican railroad, all built with American and English capital and skill, and nearly all with their materials, nor of the countless lines built elsewhere in the four quarters of the globe with English money and skill, and mostly with English iron and machinery. We seem to be pre-eminently the railroad race."

The successful beginning of the work at the new basic open-hearth steel plant in Birmingham, Ala., calls attention to the possible entrance of the South into the steel market, says the Engineering and Mining Journal. The output of that section in the past has been so closely limited to pig iron that it has not been considered at all as a competitor in steel or any finished products of steel. Of course the production is for the present so limited that it will hardly supply the needs of the Birmingham rolling mill; but there is little doubt that it can and will be increased considerably in the future. There does not seem to be any probability of the establishment of a new rail mill in the South; but a considerable trade in beams, girders and structural iron for Southern cities could be built up, and a mill at Birmingham could readily compete with the Pennsylvania works at all the cities along the Ohio, and would have a considerable advantage over them in any town on or west of the Mississippi below Cairo. It is, moreover, a question still, whether with the present low costs, both of material and labor, it would not be possible for Southern steel works to furnish billets at a price which would enable them to take at least part of the trade of those Eastern mills which work on purchased billets. It is quite possible, also, that a trade in billets and tin plate bars for export might be built up, while there are possibilities in wire rods also. As long as costs are kept down to the present limit, there will be no trouble in finding a market for Southern steel.

ELECTRICAL NOTES.

In London, England, electric propulsion is shortly to be substituted for horse traction. The lines are owned by the town, but are to be let out to companies as soon as the alterations are complete.—Uhland's Wochenschrift.

The number of persons carried by the electric cars at the Berlin Industrial Exhibition (Germany) reached its maximum on August 29, when 35,800 persons traveled on the lines, and was smallest on the 19th of May, when only 4,700 fares were taken.—Zeitschrift für Architectur.

The number of lamps supplied with the electric current in Paris (France) at the end of October, 1896, was 545,914, in London (England) 1,178,000. The current used in Paris amounted to 8,107,253 kilowatt hours, in London about 19,000,000 kilowatt hours. In Paris the price of 1 kilowatt hour is 25 cents, in London about half as much.—Zeitschrift für Architectur.

The electric lighting of railway cars is constantly coming more in use in Switzerland. The number of cars lit by electricity at the end of the year 1896 was 525. On the Jura-Simplon line electric lighting will be introduced throughout by the end of the current year. The Swiss Central Railroad has furnished all its new wagons with electric lighting appliances for the last two years. The Northeast Railroad has ordered 65 wagons, which are to be lighted by electricity. Many smaller lines, too, have followed the general motion.—Monatschrift für den Oeffentlichen Baudienst.

The municipal council of Berlin, Germany, has decided, by 58 votes against 24, that the horse cars in the German capital shall be replaced by a tramway propelled by electricity. Among the resolutions passed are the following: The right of other companies to use the tracks was restricted to a certain three sections, and 410 yards. The company shall not keep a man at work more than ten hours in succession, except in special, rare cases. Season tickets are to be issued for any line, not as heretofore for any two lines. The cars are expected to make their first trip in October.—Uhland's Wochenschrift.

A practical electrical plowing installation has been put down in France by M. Felix Prat, in the department of Tarn, says The Engineer. The power is derived from a turbine working a dynamo, the current from which is distributed to different points on the estate by four overhead lines, with copper conductors, in the form of a cable. Two of these lines are 1800 and the remaining two 1600 meters in length. These lines, wherever possible, are supported on trees—strong poplars—in order to economize posts, while securing rigid supports. The plow is drawn by a simple windlass worked by the dynamo, and can be worked to a distance of 450 meters on each side of the cable line.

A number of electrical cabs, belonging to the London Electrical Cab Company, have commenced to ply for hire in the streets of London at the same fares as are charged for the horse vehicles they are designed to supplant. In shape these cabs, which carry two persons, resemble coupes; they run on four rubber tired wheels, are comfortably upholstered in leather, and possess the luxuries of spring cushions and electric light. The driver, who sits in front, has at his right hand a small steering wheel which acts on the front pair of wheels, and at his left a single lever which regulates the speed. By means of a foot lever the driver can apply the brake and at the same time cut off the current from the motor.

The transmission of power by electricity is, in some cases, retarded in coal pits because of their fiery nature, which renders it imperative that no sparking shall ever take place where it could ignite a fiery mixture of air and gas. With direct current motors it has therefore been necessary to completely box in the commutator and brushes, which renders them rather inaccessible. The great advantages of a three-phase or a two-phase alternate current system for such work cannot be too largely brought to the notice of the public, says the Electrical Engineer. When motors of the above type and of reasonable output are used, a simple throw-on switch is all that is required in the way of regulating gear, and the contacts of this switch are the only points at which sparking can occur. It is a comparatively easy task to box in this switch gear. The motors being without commutators or collecting rings, are absolutely free from sparking. The cables leading to the motors only need protection, and there is no lack on the market of well protected concentrics which will give safety in this direction. The motors have a good starting torque, and can be relied on to drive coal cutting machinery and hauling ropes. We must admit, however, that up to the present we have not seen a satisfactory arrangement for an electric locomotive to be worked in fiery pits.

Anybody who has had much to do with books knows that it is no easy task to keep them dusted, and extremists, in view of the difficulty, have gone so far as to assert that you should never dust books, says the Electrical Engineer. They should be left undisturbed till needed, and then the rust and dust of ages can be taken off with a napkin. This, however, is regarded as the heresy of sheer laziness, and the practical suggestion is now made that the fan motor is the thing wherewith to banish grime and dust from a well kept library. All that is necessary is to turn the breeze loose over the shelves, with the windows open, and in a few minutes the tops and covers will show up in all their pristine freshness. Obviously the fans can be portable, and either carried around in the hand by a long flexible cord or hitched up at suitable plugs and left spinning. Thus dust will not be able to settle for long and will rarely have a chance to accumulate even for a single day. Electricity has, therefore, another claim to use in libraries. Gas is well known to have a deleterious effect on books, and Mr. Blades, the well known bibliographer, once said there was nothing to equal it for rotting covers, even those of leather. With electricity, a public or private library will be better lighted and better kept, while it will also be safely available more hours of each day.

MISCELLANEOUS NOTES.

Vegetable ivory may be distinguished from real, animal ivory by applying a little sulphuric acid (concentrated) to the surface of the doubtful material. After some ten to fifteen minutes the vegetable product shows a pink coloration, which may be washed off with water, while true ivory remains unchanged.—La Science en Famille.

An improved composing box for type, with a wire net bottom, has recently been patented. The wire netting is made fine or coarse, according to the type it is intended for. Under the netting a wooden bottom can be slid in like a lid. The object of the invention is to facilitate the cleaning of the box, in which dust from wearing types collects.—Uhland's Wochenschrift.

The use of gas for heating purposes, particularly for large buildings and schools, is recommended on several grounds. The easy and quick regulation of the heat given results in considerable saving, and since radiating heat is employed, a quick rise of temperature is produced. The cost of installation and keeping in repair is small. Ample ventilation is afforded through the fireplaces, the air is not deteriorated by the fire and there is no danger of explosion.—Zeitschrift für Architectur.

A process by which not only the iron but also the phosphorus may be saved from iron ores containing phosphorus was recently patented. The ores are mixed with coal, the mixture is raised to a dull red heat, and steam is led over it. Water gas is formed, which acts as a reducing agent on the iron at a temperature when the phosphorus is left unaffected. The phosphorus then remains for later treatment.—Wiener Gewerbe Zeitung.

Spices are often adulterated with the residues of similar spices, from which, however, the essence has been extracted. Thus pepper has been found to contain some forty per cent of ginger residues. Ginger itself is often only one-half aromatic, the remainder being tasteless residue. Pepper is often adulterated with ground up pepper stems. Even unground pepper is forged, ordinary white grains being colored black and sold as Singapore pepper.—Uhland's Wochenschrift.

A new device for closing tins of preserves, etc., which was recently patented in Germany, has many advantages. The process of preparing the tinned products is carried on in vacuo, much time and heat being thereby saved, since many of the preserves have to be boiled. At the same time the vacuum is taken advantage of for closing the tins. The lid is applied, after a washer has been interposed, and then the tin is taken out into the air under atmospheric pressure. To open the tin, all that is required is to bore a hole in the lid.—Wiener Gewerbe Zeitung.

Roof tiles are made in Warsowi, Russia, of thin wood sheets, which are glued on one another so that the grain of the wood is crossed. A thin, elastic plate of wood is thus obtained, which cannot by any accident be twisted out of shape. These tiles resist the action of the weather very well, after they have received an application of pitch; they will even stand boiling in water for several hours. The weight of a roofing of these tiles is 12 pounds per square yard. They can be rendered fireproof by saturation with potassium silicate (soluble glass).—Monatschrift für den Oeffentlichen Baudienst.

The ambitious scheme of the Nippon Yusen Kaisha—the Japan Steamship Company—to compete with existing lines to Europe, America and Australia has been the reverse of successful, so far as the experience of six months' working is concerned, says The Engineer. The expenditure during that period was 4,968,365 yen, inclusive of 683,145 yen for depreciation and insurance and repair reserves, while the receipts totaled 4,805,048 yen, inclusive of 440,000 yen as government subsidy and 217,093 yen in respect of navigation bounties. This shows a loss on the half year of 163,336 yen, despite which the directors declared a dividend of 10 per cent., absorbing 605,000 yen, a feat accomplished by utilizing the whole of the "dividends equalization fund," amounting to 427,561 yen, and the balance of 190,539 yen brought forward from the previous account. This reduces the available funds to 2,561 yen, which sum is to be carried forward. The Syren observes from the report that the directors look for better things in the immediate future, but the opinion of those most competent to judge is that they will look in vain, unless the directors revert to the old state of things and discontinue these long distance voyages.

The Washington Star says: "Over 20,000,000 packages of vegetable, flower and field seed have been distributed by the Department of Agriculture during the past spring. This distribution has given to each member of Congress 40,000 packages of seed, at a total cost of $130,000. Over 1,000,000 of these packages were flower seed, and nearly 300,000 field seed, the balance being a great variety of vegetables. In the entire distribution nearly every variety of vegetable known to the agriculturists was distributed. There were 32 varieties of beans, 10 varieties of beets, 23 varieties of cabbage, 11 varieties of carrots, 19 varieties of sweet corn, 18 kinds of cucumbers, 30 kinds of lettuce, 19 varieties of muskmelons, 17 kinds of watermelons and 15 varieties of onions. The entire amount of seeds distributed was sufficient to plant an area of 355 square miles, or about six times the size of the District of Columbia. This is the largest distribution of seed ever attempted by the Department of Agriculture, and it is said that seedsmen all over the country are complaining that they do not make sales to farmers and others because they are getting all the seed they want free from the Department of Agriculture. The distribution of seed in 1893 amounted to 8,900 packages for each member of Congress, at a total cost of $66,548; in 1894 each Congressman got 16,000 packages, the entire cost to the government being $57,000; in 1895 the number of packages of seeds distributed was the same as in the previous year, but the total cost was reduced to $47,000. In 1896 Congressmen got 15,000 packages each, and the government paid $80,500 for the whole lot. During the past spring each member of Congress has received 40,000 packages of seeds, for which the government has paid $130,000."

[Continued from SUPPLEMENT, No. 1132, page 18101.]

DR. MOUNT BLEYER'S TREATMENT FOR CONSUMPTION BY ELECTRICITY.

On the application of the principles underlying these experiments in the sterilization of lung tissue in tuberculosis.

The primary action of the galvanic current—It increases the amount of ozone in the blood, as shown by chemical test of the blood in the arteries—With my theory of animal electricity.*

By J. MOUNT BLEYER, M.D., F.R.A.M.S., LL.D., New York City.

PRELIMINARY TESTS.

FOR a period of seventy-two hours before entering upon the examinations, we hung in various portions of my laboratory slips of specially prepared paper saturated with a solution of iodide of starch and others moistened with tincture of guaiac. These, we all know, are acknowledged tests upon ozone. We kept the papers under careful observation, examining in strong light at intervals of an hour, and as there was no evidence of a reaction at the end of the allotted time we were justified in concluding that the atmosphere of the laboratory was free from ozone and the other gases which act upon starch and guaiac. Next we directed our attention to nitrous compounds in the air, for the reason that they, if they exist in the slightest appreciable quantity, give us a reaction very much like that of ozone, and their presence must be excluded in order to give any sensitive test for ozone practical chemical value.

The test we applied for nitrous compounds is an extremely useful one, unusually sensitive, and we give its chemistry for the benefit of those who may desire to repeat our experiments. It is named Gries' test after its discoverer. He observed that in sulphanilic acid and naphthylamine we have a reagent which acts on nitrous acid, but not on H_2O_2 or O_3. This discovery Gries made while engaged in studying the action of diazo-benzene sulphonic acid on naphthylamine.

He obtained his diazo-benzene sulphonic acid by heating sulphanilic acid with nitrous acid and calls attention to the extreme delicacy of the reaction, minute traces of nitrous acid sufficing to produce a dark red color in the presence of dilute sulphuric acid. The colored substance formed is an amido-azo derivative of the formula

$$C_6H_4(SO_3H)N = NC_{10}H_6NH_2 \dagger$$

called azo-amido-naphthalene-benzene-sulphonic acid. Prof. Slosvay ‡ of the Polytechnic school at Buda-Pesth increases the sensitiveness of the reaction by substituting acetic for sulphuric acid, and he can detect with it nitrous acid in aqueous solution in a dilution of one part nitrous acid to one thousand million parts of water.

The formula of the test is:

$$\underbrace{C_6H_4NH_2(SO_3H)}_{\text{Sulphanilic acid}} + \underbrace{C_{10}H_7NH_2}_{\text{Naphthylamine}} + HNO_2 =$$

$$C_6H_4(SO_3H)N = NC_{10}H_6NH_2$$

We availed ourselves of Slosvay's modification of Gries' formula.

A tank of a capacity of fifty gallons at a pressure of thirty pounds was filled with air from the laboratory. The air was sent through an air meter which registered one liter per minute and from this into a test tube containing distilled water through which it was allowed to bubble for ten minutes and then tested.

There was no immediate reaction, and only after half an hour's standing did we observe a tinge of color, so faint, however, as to be almost imperceptible in ordinary light. In order to see it we were obliged to back the test tube with pure white filter paper and hold it in the sunlight.

In view of the delicacy of Slosvay's reaction it was fair to assume that the quantity of nitrous acid in the air was so infinitesimally small that for practical purposes it could have no effect in interfering with the subsequent tests for ozone.

Ten liters of oxygen were treated in the same manner. The oxygen was first subjected to two washings in distilled water without giving any reaction to the nitrous acid test. The remaining forty gallons which were afterward liberated in the laboratory were washed in caustic soda and dried with sulphuric acid (c. p.) and bubbled through distilled water. There was no reaction with Gries' test, thus showing that the gas was absolutely pure and free from admixture with nitrous and other gases.

This concluded the preliminary testing. The object of the careful analyzing of the air of the laboratory, as you may already divine, was to devise means of testing for ozone in the open, and so avoid the less satisfactory method used by Schmitt, who treated his ozone in a balloon from which the oxygen had been removed as nearly as possible to do so by means of carbon dioxide, or handling it in a similar glass receiver from which all air had been exhausted, which was the manner in which Kühne conducted his experiments.

For several days work was suspended, and resumed again Monday, August 21, 1892. On that morning we were treated to a genuine surprise that caused me to ponder for awhile; and Dr. J. C. Dittrich, who, perhaps, ranks first among the authorities on ozone in this country, and who kindly assisted me in the chemical portion of my work, prepared several specially sensitive test papers, which on being moistened with distilled water, at once gave a reaction. The air of the laboratory was evidently charged with ozone, and we were at a loss to account for its presence. Speculation was soon set at rest when we recalled the violent thunder storms of the Sunday and Saturday before.

The ozone was the result of the intense static discharges of those days, and the amount that had been generated by the great Pluvius certainly was enormous and beyond measure; for that day and the three succeeding ones work had to be deferred, with all the preliminary testing for naught.

On the following Thursday, on resuming operations, no ozone or nitrous acid was detected in the laboratory, the preliminary tests on being repeated gave results as already stated.

TESTING FOR OZONE IN THE BLOOD.

A rabbit that had been well fed for a week was the subject of investigation. It was a big animal in fine spirits and weighed 4 lb. 3 oz. It was brought into the laboratory and both carotids cut through, and the blood collected in a sterilized glass receiver. In all 60 grammes were extracted and defibrinated with sterilized glass rods. The operation required nine minutes and the fresh serum was subjected to test.

The serum was diluted with distilled water in the proportion of 1 part of serum to 4 of water. With the iodide of starch an immediate reaction was observed in the open air, and the same reaction, faint at first, but gradually deepening in blue color, showed under a bell glass.

Testing with guaiac tincture of the officinal strength, which we reduced by adding an equal volume of absolute alcohol, responded more quickly to reaction of ozone. The blue ring around each drop of blood was marked and sharply defined. The same reaction continued when the test was made under the bell glass, and gradually approached a maximum of intensity at the end of half an hour, when to all appearances the ozone became completely exhausted.

The fibrinous clot with the entrapped corpuscles was likewise tested and gave a far more distinct and marked reaction than the serum.

It was evident at a glance that the corpuscles contained a far larger amount of ozone than the plasma.

The remainder of the defibrinated blood, about 40 grammes, which had been kept in a well covered jar, was next subjected to electrification for five minutes.

A galvanic current of 10 volts and 15 mil-amperes was sent through the fluid. The electrodes used being strips of platinum an inch long and ⅛ inch wide.

In six seconds the meter dropped to 8 mil-amperes, and the registration which was recorded at the end of each minute read as follows:

1	minute	7	mil-amperes.
2	"	5	"
3	"	4·5	"
4	"	3·75	"
5	"	3 +	"

Testing with iodide of starch and guaiac tincture showed the unmistakable increase of ozone. The rings around the drops of blood were of deep blue hue and the reaction continued on with much greater rapidity than was the case of the unelectrified blood. As quantitative test was out of the question, Dr. Dittrich made an approximation of the intensity of the action by comparing the rapidly deepening ring of blue with the chromatic scale given by Dr. Foer in his exhaustive work on ozone. They carefully noted the change of color as it progressed, availing themselves of the most advantageous light facilities, and agreed upon the estimate that the amount of ozone adequate to such reaction must be in the neighborhood of, at the lowest calculation, at least 2¼ times greater than the amount indicated by the reaction in the case of the unelectrified blood. The clot deposited around the electrode at the positive pole gave a more annealed reaction, the ring of blue almost approaching indigo, showing a most marked increase over the former reaction.

Standing by itself this test of the blood outside of the body signifies but little, for it is the blood that circulates through the living organism unimpeded with which we have to deal and in which physiological conditions alone can be of any value in the study of the action of the galvanic current. Yet withal when taken in connection with the tests that were afterward made, the observations form an important link in the chain of evidence that it is animal electricity which is the polariser of the atoms of neutral oxygen both in the plasma and in the hemoglobin.

Under normal conditions the transformation of O_2 into O_3 is slow and gradual and the polarization of the neutral oxygen is proportionate to the polarizing force of the existing animal electricity.

Undoubtedly Schmitt, Houzeau, Meisner, Kühne and others were right in their assumptions, but it seems to me that they did not probe deep enough for a solution of the possible origin of this transformation of neutral oxygen into ozone within the human economy. It was due to the polarization of the atoms of the neutral oxygen, but how did it come about.

I have assumed, in starting out upon the experiments the results of which form the title of the paper I have the honor of presenting to your consideration, together with the more exact details which I hope to announce at some future day, step by step, with the view of adding some light to the question, that this generation of ozone admits of a satisfactory scientific explanation.

During the years that I have devoted to the study of ozone within the body I have always regarded it with awe and veneration. I have woven theory after theory only to find that the strands broke precisely within the limits of the reasoning of the great observers to whom we owe all I know of ozone, and that to us as physiologists is indeed little.

That ozone can be found in the blood nourished by gases that contain no ozone is a fact beyond dispute, yet the problem of its generation is a problem that at first sight offers no easy solution.

In looking over the field of possible sources to explain this source of formation of ozone, it fastened itself upon me that one great factor that might afford an explanation of its generation had been overlooked. It was animal electricity, and I have tried to explain its function. There seems to be but one deduction to draw from the most careful observation, and that is, that it is animal electricity upon which not only the polarization of the atoms of oxygen, but all molecular polarization and chemical action in the body depends.

I believe that the transformation of oxygen into ozone within the body is brought about by this very animal electricity, which polarizes the neutral oxygen to such a degree that a portion of them rearrange themselves, attract and repel each other under this polarizing force until we get the ozone which we detect upon analysis. The function of the ozone is apparent to all of us. It gives the oxygen increased power to form combinations with the tissue elements and promotes oxidation.

This polarization of the oxygen seems to take place just as the gas touches the tissues where the conditions are favorable to such an action and where it closes circuit with electricity in the human frame. The unaffected molecules of oxygen under the vigorous spurring of this ozone become vitalized, as it were, and at once begin the search for their affinities in the tissues and enter into combination with them.

The proof of this reasoning seems to me to be apparent from the fact that I have been able to appreciably increase the amount of ozone in the blood by passing very weak currents of galvanic electricity through the body, and it is the underlying theory upon which I based my experiments and which I hope to make clear to you.

Before dismissing this portion of my paper and passing over to an account of our experiments upon the blood of the living animal electrified by a current of galvanic electricity, permit me to advance another theory which I regard as justifiable from my findings, and I do so only in the hope that it will give rise to careful discussion, for it is at variance with some of our pet physiological theories. It is that oxygen in the blood, stimulated by the polarizing power of animal electricity, and more so under the stimulus of the galvanic current, enters into combination with the hemoglobin of the corpuscles with a partial transformation into ozone, and that in losing its combining bonds it undergoes a further partial transformation into ozone.

EXPERIMENTS ON THE ELECTRIFIED ANIMAL.

This brings me to a record of the experiments upon the living animal with the galvanic current.

The animal chosen was also a rabbit, which was prepared by being fed on fresh vegetables for several days. He was in prime condition and was allowed to run at large until he was required for use. The batteries were carefully tested cell by cell and the current measured with both volt and mil-ampere meter. A coil of a resistance of 400 ohms, which had been placed in the circuit, was removed after the measurements had been taken, and we decided upon a current of a strength not to exceed 40 mil amperes.

Two cuts about half an inch apart were made into the skin of the animal, and into these and for a distance into the body of the muscle the platinum electrodes used in the previous experiment were inserted, and a current of 20 volts turned on. The meter showed 44 mil-amperes. This dropped quickly down to 41 mil-amperes. The reading of the meter during the five minutes that the current flowed was as follows:

1	minute	40·5	mil-amperes.
2	"	38	" "
3	"	37+	" "
4	"	35·8	" "
5	"	35	" "

At the end of five minutes both carotids were cut through and 35 grammes of blood were drawn into a sterilized glass vessel and defibrinated as before with sterilized glass rods.

It was observed that the blood was of a brighter scarlet hue than that which flowed from the arteries of the unelectrified animal. Exposure to the air while the process of defibrination was going on did not affect the bright tint. Defibrination, too, was not so easily effected, and the fibrine slowly gathered around the rods.

Seven minutes after the blood was shed a gramme of the fresh serum was diluted with two grammes of distilled water and subjected to tests with both guaiac and starch iodide. The reaction in both instances was almost immediate, a trifle more active with the guaiac. The ring of blue around the drops of blood was more pronounced and much deeper, and kept on deepening both in the open air and under the bell jar as had been done with the blood from the first animal killed. At the end of 20 minutes the test papers, those saturated with guaiac and starch iodide, three of each variety being exposed to the air and a similar number under bell jars, indicated the termination of the action, and they were taken out and carefully compared with the test records of the first experiment, which had been preserved in airtight tubes. The blue ring was even upon the most superficial examination found to be several shades deeper, and the ring of reaction was more spreading, in some of the drops almost half an inch wide and distinctly visible to the line of demarcation of chemical action. The fibrin also gave like results. A far larger amount of iodine had been set free in these tests than in the case of the first analysis. The quantity of ozone to give such reaction, according to a most conservative calculation of Dr. Dittrich, was estimated to be certainly three times greater than that which gave the reaction from the normal blood. The increase in the amount of ozone was astonishing and far beyond our expectations. We had anticipated some difficulty in determining the increase if it proved to be trifling, but here we were met by a quantity far in excess of what we had hoped to find, in the event of the most successful termination of our searching.

The action of the current on the oxygen in both the plasma and corpuscle enmeshed fibrin was evident in the transformation of a portion of it into the more vital form of O_3. That the current had accomplished this transformation, astonishing as it proved to be, was readily to be explained, but not so with the ozone in the normal blood. There was but one explanation for this—the polarizing action of the animal electricity.

MY PLAIN VIEWS REGARDING ANIMAL ELECTRICITY.

The existence of animal electricity is acknowledged. Its origin and action, however, are the points upon which electro-physiologists are not quite clear. Those who have given the subject some consideration dismiss it by establishing its connection between chemical action, heat and animal electricity. They rest contented in discussing the three conditions without attaching the slightest importance to the precedence of one or the other of them. Chemical action, we are told, evolves heat, and so tissue metamorphosis and oxidation go on. They are satisfied with the evidences of the existence of animal electricity, that it can be measured, and that it is one of the great trinity upon which life rests.

It is in view of this condition of the investigations

* Read before the Twelfth International Medical Congress, Moscow, Russia, August 19, 1897. By special invitation.

† Ber. d. Chem. Gesell., 12, 431; 15, 2291.

‡ Bulletin de la Société Chimique de Paris, September and November, 1889.

upon this question that I approach it with much trepidation and fear, lest I be charged with being too radical in my deductions. I can almost see doubt written upon the faces of many of this distinguished gathering and I can almost hear you say: Well, are you going to settle this question? Settle the question or not, still I have the boldness to advance a probable solution of the problem, and I ask you to follow closely my experimentation and the deduction I have drawn and based my opinions upon. I will not take up your time by rehearsing the observations of the various electro-physiologists who have enlightened us in animal electricity. To do so I would in fairness to all be obliged to begin with Matteucchi and so on up to the present day without omitting a single one, for each of the observers has welded a link in the chain of results, and to leave out a link would mean to destroy the integrity of the chain.

Let us for a moment consider the observations of Dutrochet and we may get a clew to the true function of animal electricity. He observed that if the positive pole of a battery be dipped into pure water and the negative in gum water, endosmosis continued more energetically.

Onimus later on discovered that with a reversal of this order of poles, endosmosis too was reversed. It is but fair, reasoning again by analogy, to assume that the electricity in the body exercises precisely the same physico-chemical action. I have already called your attention to the observations of Gay-Lussac. Whenever the so-called catalytic action takes place in the living tissue, is it not equally fair to assume that animal electricity is the prime mover? Can there be any question that electricity, a form of galvanic, with its electrolytic powers, of the ready manner with which it decomposes the salts, coagulates albumen in the vessels of our laboratories, has a like action on the tissues and fluids of the living organism?

It is apparent I hold that animal electricity not only influences the whole system of nutritive operations but also directs them.

Time and again I have electrified human beings and animals and observed that under certain conditions of electrification the animals and beings threw off a greater amount of urea and carbonic acid than under ordinary conditions.

Urea and carbonic acid! And what is the significance of such an increase in the waste products?

Nothing more and nothing short of increased chemical action, increased tissue metamorphosis, the increased evolution of heat; but the electricity, the animal electricity, that remains unaccounted for. Dutrochet and Onimus showed us the action of the anode and the cathode in endosmosis, and left us to apply it to the physiology of nutrition. Now let us do so, and account for the function of animal electricity if we can. As I have already intimated, the order of act on is animal electricity first, and why? Because we must have polarity before we can have chemical action and its natural result, heat.

Subject a solution of the iodide of potassium to electrification and you free the iodine. Inject a quantity of this fluid into the blood of a living animal and then subject the animal to electrification, and, in a very few minutes, starch papers held near in contact with the parts surrounding the positive pole will indicate that the iodine is set free by the action of that pole. Note the transfer of the chemical action from the laboratory to the living body—are the two not singularly alike?

Unfortunately, I have not been able to isolate the poles of animal electricity, and hence it is that my tests on animals similarly injected, yet not electrified, give me such indistinct reactions that we hesitate to announce them as positive results.

Yet all this points to the one conclusion and the one deduction—that animal electricity comes first; that is, the prime factor in all the processes of change, of chemical action or otherwise, within the living body. That without its stimulus of polarization, no chemical action can be called into life, and, consequently, none can go on, and tissue metamorphosis, which is life itself, must cease.

Before concluding, allow me a word or two upon ozone, its physiological and therapeutical value, which are not under discussion, and are hardly properly to be considered in the limits of this paper. We have dealt with ozone generated from the oxygen within the body, and it is in this form that it plays its so important role in the oxidation of the tissues. There seems to be some doubt as to the possibility of introducing ozone in its pristine integrity into the system. It may be a feat within the range of possibility, judging from the voluminous literature upon the subject that has been published only within the last year or more; yet, from my experience in handling it, I prefer to regard it as an agent that performs its most useful work upon the field where it is ushered into existence, where nature calls it into life because it is needed to perform important duties.

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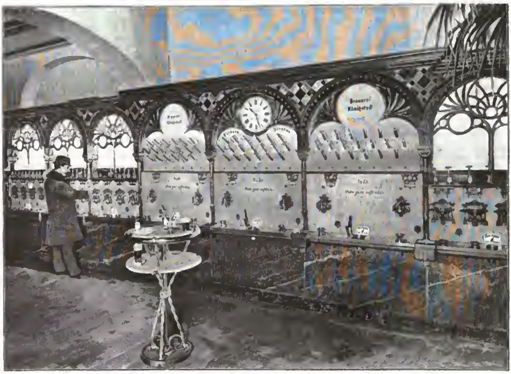
THE AUTOMATIC LUNCH COUNTER IN LEIPZIGERSTRASSE, BERLIN.

WE had occasion to refer in the SCIENTIFIC AMERICAN for December 5, 1896, to a description of a restaurant in the Potsdamerstrasse, Berlin, Germany, where visitors are supplied with food by an automatic system.

The counters are built into the walls, and are surmounted by panels in which the automatic delivery arrangements are located. These are mainly of two kinds: Such as provide solid food and others from which drinks can be served. A person wishing to take lunch in the establishment follows the series of panels, each of which is labeled, and drops his coin into the proper slot by which a plate is lowered to the counter and another brought into position for the next customer. If the lunch is to be supplemented with a glass of any beverage, a glass is taken down from a peg, rinsed in a jet of water, and again a coin is dropped into the proper slot. Now the corresponding tap is placed automatically at the disposal of the purchaser, but, being regulated by clockwork, it measures out to him just one glassful. There are tables at which one can stand for the meal, or, if he prefers to sit down, he can have a chair and put his plate on the shelf of the table.

The prices are plainly marked for each variety of food, and range from ten pfennig to fifty pfennig, or about from two to twelve cents, which represents considerably more in Germany than in this country. The full plates are in view of the customers. All is kept very neat and cleanly, and the paneling is very tasteful and



AUTOMATIC SERVING OF LIQUID REFRESHMENTS.

AUTOMATIC SERVING OF SOLID FOOD.

THE AUTOMATIC LUNCH COUNTER IN BERLIN.

even artistic, and the whole locality is calculated to stimulate the appetite. On the wall we see in one of our illustrations the word "Bediene," which is the first word of the inscription "Bediene Dich Selbst" (help yourself), in imitation of the well known "γνῶθι σεαυτόν."

No doubt this arrangement will be found quite satisfactory, as the automatic distribution of tickets at the railway stations of the German capital has been, for, on one hand, the purchasers are free and undisturbed in their selection, and, on the other hand, the management of such a restaurant is very simple, requiring very little personal work. Such work is restricted to the preparation of the meals, and the refilling of empty plates and tanks. For our engraving and the foregoing particulars we are indebted to Ueber Land und Meer.

OUR GREAT GRAIN CROP—FUTURE OF THE BUSINESS.*

THE MOVEMENT OF THE CEREAL FOODS IN THE WESTERN HEMISPHERE: THEIR PRODUCTION, TRANSPORTATION, DUTIES AND CONSUMPTION.

By Dr. William P. Wilson, Director of the Philadelphia Commercial Museums.

In an assembly of millers at this time the unusual conditions of the grain and flour market in the immediate present are likely to be of more interest and attract more attention than the possibilities of future markets under normal conditions. As wise business men, it is well to forecast the future possibilities and, if in our power, to provide for a permanent outlet for our surplus flour, even when other wheat-producing nations have good harvests and are likely to export their usual quantities of wheat and flour.

The best authorities claim that the probable requirements of European importing countries for 1897 and 1898 will be 411,200,000 bushels, of which Great Britain will require 180,000,000. The actual exports during the year ending July 31, 1897, were 366,440,000 bushels, of which the United States and Canada exported 138,000,000; Russia, 112,000,000; Turkey and the Balkan States, 70,000,000; Argentine, 3,400,000; India, 1,040,000; Austria-Hungary, 22,000,000. After making all allowances, the United States and Canada will have to export 300,000,000 bushels of wheat to meet the demand of Europe, or 202,000,000 bushels annual amount larger than has been ever exported to Europe from these countries—in addition to what is needed for extra-European countries.

We congratulate the farmers and millers of the country on the prospects of the present year; but, realizing that other conditions may exist in another year, when Europe will not require so much from us, we feel it is the part of wisdom to look for other markets. In Europe we are liable to meet—as we have met—competition from other European countries and from Argentine, Australia, India and Egypt, which will cause the prices of flour and grain to fall below that which would return a fair reward for the labor employed in producing them. During the last twenty-five years the average annual exportation of wheat and flour has been 258,000,000 bushels from all exporting countries and 111,000,000 annual from the United States. During the last five years the average annual exportation from all countries has been 345,000,000 bushels, while that of the United States has been 164,000,000; so that, despite the fact that new wheat-producing countries like Argentine, Australia and Roumania have entered in the race, the United States still holds about the same percentage of the total amount exported. In Europe, the number of competitors is increasing to such an extent that if it were not for other markets, we should be in a sad plight before many years. In flour the United States has fallen off 2,000,000 barrels in amount exported, from the year ending June 30, 1893, when 16,620,339 barrels were exported, to the year ending June 30, 1897, when only 14,569,545 barrels were exported. During the year ending June 30, 1896, 14,000,211 barrels were exported—Great Britain taking 8,211,236 barrels; Brazil, 871,475; Hong-Kong, 890,000 barrels; Canada, 802,000 barrels. Europe, with all her millions of people outside of Great Britain, took less than 1,000,000 barrels, while the countries south of us took 3,000,000 barrels—almost as much as all the rest of the world combined outside of Great Britain. Asia, which has not been considered, until of late, as a market for flour, takes over a million barrels.

The market to which Americans will have to take their surplus flour is the country south of us (the Atlantic countries), South Africa, and the Asiatic countries. European countries are more likely to import our wheat and make their own flour; while the other countries are more than likely to continue to do as they are now doing—import more flour than wheat. Of the 21,000,000 cwt of flour imported by Great Britain, 15,100,000 cwt. came from the United States; 1,932,100 cwt. from British North America; 1,602,000 from France; 1,398,000 from Austria, and 204,790 cwt. from Germany. In Europe we not only have to meet the competition of the other wheat-producing countries, but nations like France will import wheat and turn it into flour and compete with our millers in the British market. In the new market of South Africa we have made rapid strides. In 1895 the whole of South Africa imported only $111,750 worth of flour. In 1896 they imported $945,000, almost a million dollars. From the United States in the month of March, 1897, the importation was 300 per cent. greater than the corresponding period of 1896; that is, for the month of March, 1897, 300 per cent. greater than in the same month of 1896, showing the rapid growth of the export of flour to that country. The statistics of Cape Colony show that in 1896, of 13,896,392 lb. of wheat flour imported, over thirteen million came from the United States—seven million from the Pacific and six millions from the Atlantic coast of the United States. The tariff on this flour was $1.22 per cwt. The remarkable increase of exports to Asiatic ports in the last decade from 409,147 barrels in 1887 to 943,673 barrels in 1896 shows a gain of over 100 per cent.; and for nine months ending March 31, 1897, 882,204 barrels, which reached a million barrels before June 30, 1897. The shipments in this direction were mainly flour, and therefore of more interest to a miller. In Japan it appears that the capacity of that country for wheat production has not increased as rapidly as the population; and, therefore, the need of importation. Japan with her 42,000,000 and China with her 400,000,000 inhabitants—once the habit of using flour becomes general—will become a market capable of taking any surplus that we have. In China and Japan wheat is admitted free; while in most European countries flour is discriminated against by levying a higher duty on flour than wheat. This trade will not be held by the Pacific millers alone. Of the 30,000,000 cwt. flour imported by Great Britain from the United States, 20,000,000 comes from the Atlantic and 10,000,000 from the Pacific coast, that is, that goes to Great Britain. The extraordinary increase in the last few years of exportation of flour to Asia gives a reason to look for the continuation of the same increase in the future; and in this market European nations are not likely to compete.

In South America, Argentine, Chile and Uruguay are exporters of wheat, and Argentine and Chile exporters of flour. Chile exported, in 1895, 40,621 barrels, of which 16,300 went to Peru, 19,720 to Ecuador, 400 barrels only to Colombia and 77 barrels to Guatemala, leaving about 4,000 to be distributed among Bolivia and other nations. The Argentine Republic exported in 1895 606,000 barrels of flour, of which 535,000 went to Brazil, the remaining 70,000 being scattered among England, Germany and other nations. Of the 301,000 barrels exported in the first six months of 1897 from the Argentine Republic, 299,000 went to Brazil—almost all of it. Very little Argentine flour goes to Europe, owing to the danger to the condition of the flour in crossing the tropics, which is not a matter to be disregarded.

The countries south of us, that are possible markets, have a population of 33,000,000 inhabitants, including Mexico, Central and the South American countries; and some of them are now importers of flour. At present Brazil takes 871,478 barrels; British West Indies, 572,842 barrels; Central America, 250,000 barrels; Venezuela, 218,000; Hayti, 197,000; Cuba, 176,000; British Guiana, 167,000; Colombia, 138,406; Porto Rico, 120,021; French West Indies, 109,118; and in other countries in smaller amounts, giving a total of 3,000,000 barrels, a market second only to that of Great Britain, and one in which Argentine alone is a large competitor, the amount of Chile's export being small, and her location excluding her from a large part of this territory. With these countries we should endeavor not only to hold, but also to increase our trade. Reciprocity in the past has done something to increase this trade, the effect of it in Brazil and Cuba being quite marked, as well as in Germany and France.

During the time when we had reciprocity with Brazil we had the following conditions: Brazil placed wheat, corn, seeds, flour, oil, coal, machinery and tools on the free list, and reduced the tariff on a number of other articles 25 per cent. in order to avoid a tax on coffee and secure admission free for her sugar. The effect on flour can be seen from the following: Two years before reciprocity came into effect, in 1890 (first year), we sent 687,342 barrels to Brazil; in 1891 we sent 722,369. Those are the two years preceding reciprocity. The first year of reciprocity we increased from 700,000 to over 900,000 barrels; and the next year (1893) we dropped off a trifle to 887,000; in 1894 we went up to 920,896 barrels. After that reciprocity was dropped. We dropped immediately the next year to something like 700,000 barrels. Flour during reciprocity was admitted free, now it is taxed at 57½c. a barrel. That is extremely low. In Cuba the effect on flour was as follows: Before reciprocity 114,000 barrels (the last year before introduced into Cuba); the next year it went up to a trifle over 300,000 barrels; the next year (1893) to over 600,000; the next year (1894) to 662,000; and the very first year that reciprocity was dropped it went down to 255,000. For Cuba, prior to reciprocity the tariff was $3.35 per barrel on flour. It was reduced to 88c. during reciprocity, and increased to $3.66 after. In Cuba free sugar was gained by the reduction on American products; in Brazil, free coffee and other things. Our great drawback is the high tariff imposed upon flour in most of these countries, largely for revenue purposes, but also, in some countries, to protect the home market. Reciprocity, therefore, might improve some of this; and, if it can be done, perhaps the 200,000,000 barrels of flour which we have dropped recently in our exportation since 1893 would be brought back again by reciprocity. If it could be so, it would be an object well worthy of the most arduous efforts of this association. If without reciprocity we are able to sell Brazil more than Argentine, her next neighbor, sells, how much more we would be likely to sell with reciprocity no one can say.

As Argentine is our greatest competitor, would it not be well to look more closely into her capabilities? The area of Argentine which is suitable for cultivation of wheat is 240,000,000 acres. Argentine takes in the whole of the southern part of South America; now includes Patagonia and runs up well north into the middle part of Brazil, the upper part being tropical; the whole middle part being temperate, and when you get down as low as Buenos Ayres, you have a climate not as cold as here—having frost and a little snow in winter, sometimes, but a very mild climate; and the whole of the region for many hundreds of miles north of Buenos Ayres and a great distance south is a wheat growing region, with very rich lands. Of the 240,000,000 acres in Argentine suitable for wheat growing, there are at the present time only a little over 7,000,000 acres cultivated for wheat.

In 1894, Argentine's best year (grasshoppers have eaten the wheat up, mostly, during the last year), Argentine exported 59,000,000 bushels of wheat and 459,527 barrels of flour. In 1895 it dropped off to 35,000,000 with, however, a little more flour (607,000 barrels of flour—the mills were increasing); in 1896 the exports dropped to 21,000,000 bushels of wheat (remember, in 1894 it had been 59,000,000), and the exportation of flour dropped down to 472,000 barrels; in 1897—a very bad year for the Argentine—the exportation of wheat was only 3,000,000 bushels and the flour 301,000 barrels. Twenty years ago, however, Argentine imported wheat and flour for her own consumption. Now it is the third wheat exporting nation; and although, at present, it is not a very important factor in the market, it will no doubt, in future, be a very large exporter of wheat and flour. In the Argentine Republic the cost of the production of wheat is estimated at 21 cents a bushel, not including cost of the land.

The average freight to Europe is only 15 cents a bushel; the nearness of the railroad stations to the seaboard averages only a hundred miles, as against the 1,000 miles of American travel. This is an important factor in favor of Argentine. There are in the Argentine Republic at the present time 416 flouring mills, of which 276 have modern machinery and are capable of producing 14,806,000 barrels of flour; but the actual output for consumption and export does not amount to more than 30 per cent. of this. In addition to the 276 mills are 18 second class and 122 third class mills. A factor in the price of wheat, and also of flour, is the low cost of living; the small farmers (who are principally Italians) live on a scale that the Americans could not endure; and with large families, all of them—from grandmother to children of tender years—joining in the work, they are able to put wheat on the market at a less rate than the American. If it were not for the poor facilities of handling the wheat from the farm to the railroad, they could produce it cheaper. They have no barns and are compelled to hurry the grain to the station as soon as it is harvested. Here there are rarely any warehouses; and the crop suffers much injury before it reaches the seaboard. At the wheat moving season in the Argentine Republic it is not uncommon to see, stacked up, hundreds of thousands of sacks of wheat at the stations without any covering. The different kinds of wheat grown in the Argentine may be of interest. Barletta, a hard red wheat, is principally grown in Santa Fe; the wheat from Antre Rios is somewhat superior; the wheat grown by the Russian farmers near Pramenti has a high reputation. Barletta varies in color, size and plumpness, sometimes looking like the original barletta seed that came from Italy, but always containing a considerable amount of gluten. The Tussala wheat is smaller, gray-back, with less strength but better color; and is sometimes not easy to distinguish it from the interior Russian, Bulgarian or Lombardy wheats. French wheat is grown considerably in Buenos Ayres because it gives a very large yield; but it is more tender than barletta. It is short on gluten. The Bahia blanca wheat is the nearest like the American red wheat.

The Uruguayan wheat is not as good as the Argentine wheat, being deficient in strength. There is a great irregularity in the River Platte wheat, which is also augmented by the bad handling afterward.

In order to develop trade with southern countries on this continent, it will be well for millers to familiarize themselves with facts concerning the existing trade of these countries. The statistics of the United States show that no flour was exported to Argentine, Uruguay, or Paraguay, and to Chile and Bolivia practically none—the amount was so small; all of these but Bolivia and Paraguay being wheat exporting countries and supplying their own wants, and these two being largely supplied from their neighboring countries. Peru takes only 6,000 barrels and Ecuador 20,000—their wants being practically supplied by Chile. These two countries might be reached from the Pacific coast, but not from the Atlantic. The 3,000,000 barrels were mainly sold to Brazil, West Indies, South American countries on the Caribbean Sea and Central America.

Brazil, with her 14,000,000 population and the next largest customer for flour after Great Britain, has four flour mills only, for which wheat is largely imported from the River Platte—17,000,000 bushels having been imported in 1894. These mills are graded: First, the English flour mill—the Rio de Janeiro—50 sack plant (meaning 280 bushels to a sack); one fluminense of Rio de Janeiro—30 sack plant; another of the four mills only a 5 sack plant, and another only three; that comprises the local mills of Brazil. The market in Brazil can be, contrary to general opinion, reached by a number of lines. There are regular steam lines from New York—among them, that of Slohmann & Prinz; and in addition to these there are a number of packet lines whose rates would be considerably lower for Rio and other ports. For more northern ports there is the Red Cross Line and one or two others; and sailing vessels could also be used. In the northern ports there are practically no competitors; and the only problem is to get sufficiently low rates to enable the flour to be sold at a price to find purchasers. In Rio, Argentine enters into competition; but as American flour is preferred, and sells, too, at a higher rate, there is no doubt, if trade were pushed and rates could be made low, it would enable the American flour to drive the ordinary flour out of the market; and especially if, under reciprocity, American flour was admitted free, instead of paying 57½c. duty, the Brazilian trade would take a million barrels instead of 75,000, as in 1896—if the millers would take the matter in hand and do the business promptly. The brands most quoted in these markets are Richmond 1 and 2 and Baltimore 1 and 2, and always at a higher price than the Argentine and Brazilian. Brazilian importers of flour claim that the market could be greatly enlarged if rates could be made lower, which could be done if sailing vessel rates could be obtained.

Cuba imported 664,000 barrels in 1893 under reciprocity and fell off 379,000 after reciprocity, taking in 1897 only 176,000 barrels, owing to conditions caused by the war. Cuba, under normal conditions and under reciprocity, could be counted on for 500,000 more barrels than last year. That would make 600,000 or 700,000, or one-fourth of the whole deficiency which we are now laboring under.

Mexico exported 645 bushels of wheat and 3 barrels of flour and imported 50,000 bushels of wheat and 46,819 barrels of flour. Although it has 12,000,000 population, it imports very little flour. First, because it is, contrary to general belief, a wheat-producing country and it is able to supply its own wants to a large extent; and, secondly, because of the high tariff, $4.30 a barrel, with 7 per cent. stamp duty added.

Now, a word about Venezuela. Venezuela imports 218,224 barrels, which amount would be much larger if it were not for the high duty, the duty on flour, including the internal revenue, amounting to 2½ cents per pound. Practically all the flour used in this country is imported from the United States, a very small amount also from Austria. The consumption is not great, as it is only used by the wealthy people. The grade used by the ordinary people throughout Venezuela is made from corn prepared at mills located in the various cities. The corn raised in the country is entirely raised for home consumption, and to protect this the present duty is established. Venezuela has declined to reduce the

* An address before the Pennsylvania State Millers' Association.

duty on flour, claiming that if the flour is imported it will come into general use and destroy the market that now exists for their own production of corn.

Guiana, Central America and the West Indies are so situated with reference to the United States as to make it possible for our millers to undersell all their competitors. If it were not for the high tariffs in all these countries, a much larger amount would be consumed. In the countries south of us, whose products are largely consumed by the United States, reciprocal arrangements would be desirable and beneficial to both parties. The possible increase of trade in these countries would probably give over 1,000,000 barrels out of the 2,000,000 we have fallen off, and the new markets in Asia and Africa would make another million. Familiarity with the tariffs, freight, customs and languages of these countries would greatly facilitate this trade.

To aid in bringing about this result, the Philadelphia museums have been established. In order to build up trade with foreign countries, it is necessary to go to work in a practical way. Certain points must always be considered—use, demand; the demand and the supply; by whom and with what particular duties; the prices at which (with the duties added) goods are bought and sold; the freight and duty to which they are subject; and, lastly, the houses that handle them. The general reputation of theses houses must be examined and every item connected with the shipment of goods and collections of payments must receive consideration. All this and much more is done by the Philadelphia Commercial Museums.

[Continued from SUPPLEMENT, No. 1131, page 18094.]

THE SCIENCE OF HUMANITY.*

By W. J. McGEE.

5. THE most elusive attributes of humanity are those manifested in conduct and feeling and thought; yet, paradoxically, it was these obscure products of intellectual activity that men first sought to guide and control, for in every generation in each stage of culture, from the lowest savagery to the highest enlightenment, parents have essayed to train their children, while first the tribal leaders and later the sages and statesmen have, semi-consciously or in full consciousness, striven ceaselessly to shape the mind of the masses. So education, or the voluntary control of individual mentality for the common good, has affected profoundly the entire course of human development and has served ever to widen the chasm separating man from the beasts. In the earlier stages of culture, as indicated by the customs of savages still living, education was limited to the lowly esthetic and industrial activity of the prime; for the primitive thinker ascribes motive, complex feeling, and all but the simplest actions to ill conceived extraneous potencies against which it were bootless to strive. In higher savagery and in barbarism, the sphere of education extended to those features of conduct involved in the maintenance of tribal relations, and was effected partly by means of habitual appeal to the extraneous potencies, which were gradually crystallized in mythic systems themselves arising in a certain order determined partly by educational practice; for in much of savagery and in all of barbarism the sources of sentiment and motive are sought outside the individual and largely beyond the realm of the real. With the birth of civilization, education extended to feeling and thought, partly through appeal to ideal potencies, and there was a tendency to exalt the esthetic and neglect the industrial; and certain educational systems rose so high into the supernal or passed so far into the metaphysical as to lose sight alike of individual conduct and of the sources of real knowledge. In modern enlightenment, especially in America, the methods and purposes of training are shaped by science, and, despite the struggle of the scholastics, education is becoming revolutionized. With the recognition of an actual universe knowable through sense and reason, training becomes definite in plan and useful in purpose; with the recognition of cerebral function and of the influence of exercise in developing the brain, the scientific psychologists of the present decade have gone far in erecting a new platform for pedagogy; and with the recognition of the relations among the activities and the activital products of man, the normal course of intellectual development would appear to have been made clear, for it seems manifest that just as observation begins with the simple and proceeds toward the complex, and just as activity begins with the spontaneous and passes into the volitional, so individual and collective mentality must arise in simple and perhaps spontaneous action, to grow through habit into sentiment, and to mature through unconscious or conscious thought in definite motive. It is heterodox, perhaps in more senses than one, to affirm that motive—the noblest character of humanity—finds in spontaneous action, blossoms in subconscious habit, and attains fruition in the highest intellectual activity, whether unconscious or conscious, of which the individual or group is capable; certainly the affirmation represents complete inversion of a notion dominant in savagery, prevalent in barbarism, and gradually weakening through civilization; yet it is sustained by all that is known of the processes of acquiring knowledge, by the history of the growth of knowledge in general, and, indeed, by nearly all applied statecraft and most applied priestcraft throughout human history. The recognition of the genesis and antecedents of motive must afford a vantage point for a clearer survey of the vast field of human emotion, affection, passion, aspiration, disposition; and, at the same time, it cannot fail to give a keynote for improved education, for the still more complete control of mind.

These are but a few of the many ways† in which the great science based on human activities tends to bring order out of that vast chaos of action and thought which has so long resisted analysis and synthesis—that last citadel of the unknown.

AND OF THE BASIS AND END OF THE SCIENCE OF HUMANITY.

Hitherto humanity has been the theme of poesy and romance rather than of sober science. All men have perceived that their kind possess attributes distinguishing them from the rocks and plants and beasts of lower nature, yet for the most part these attributes were either ignored or transfigured into a dazzling halo which defied analysis none the less by reason of its subjective character; even to-day and in the most enlightened circles of the most enlightened nations there are few willing to consider and content to consider dispassionately the purely human attributes; but to these few the chaos of industries and ideals, of emotions and passions, of conduct and motive, and of all other things human falls into a simple order nearly as definite as the order recognized in each of the older sciences—the order of human activities and activital products.

Exact knowledge began with the remote and progressed toward the near. With every stage of progress it has been a power for the conquest of natural forces and conditions, has exalted intellectual mankind above all brainless or small brained creatures, and has made continually for human welfare and happiness; and now that the methods and purposes of science are extending to the human body and brain it cannot be doubted that these, like all other material things, will be controlled and reconstructed for the good and the glory of intelligent man. This is the end of the science of humanity.

* Continuation of a paper read before the American Association for Advancement of Science, August, 1897.

† One of these is the control of society itself for the common good, as known by Ward in his masterly memoir on "Dynamic Sociology," which it must suffice to mention merely.

THE BRITISH ASSOCIATION—ADDRESS IN MECHANICS.

THE address in Section G was delivered by Mr. G. F. Deacon, M.I.C.E., who referred to the great progress which has been made in mechanical science. After some introductory remarks, he said: It is not proposed to discuss the progress and prosperity which mechanical science has brought about in the Victorian era, much less that which the succeeding years will yield; but I venture to think that a proper subject for consideration from this chair, if not for discussion in this section, is to be found in any unnecessary waste of energy which may occur in the process of mental development of the men who are to succeed us in the great work to which we devote our lives. Having myself passed as an ordinary apprentice through workshops of mechanical engineering in the old days when working hours were longer than they are now—from six in the morning till six in the evening—and that, too, on the banks of the Clyde, where no special indulgence was given to what was sometimes called the "gentleman apprentice," and feeling convinced, as I still do, of the immense and permanent advantage derived from that experience, I shall not be judged to underrate its value in the case of others who have yet to choose the details of the career by which they expect to gain a place in the profession or business of an engineer. On the other hand, as a student thirty-four years ago under the late Prof. Macquorn Rankine and the present Lord Kelvin, I shall not be prone to underestimate the advantages of academical training in its proper application to the profession to which I am proud to belong.

TRAINING OF ENGINEERS.

Do not suppose that I think the training of the born engineer should not be controlled. He will stand head and shoulders above the rest of us whatever we may do with him; but in order that his exceptional parts may not wreck him as an engineer, and in order that his energies may be rightly directed at the start, he, too, should have the advantages of that systematic training which to his less gifted brethren is becoming more and more absolutely essential to success. At the time I began practice the large majority of young engineers were left entirely to their own devices so far as the attainment of any scientific knowledge was concerned. As pupils or apprentices, articled or not, they entered an engineer's works or office; for a certain number of years they had the run of the place and some encouragement if they worked well, but it could not in the nature of things, amount to much more. This was a very necessary, perhaps the most necessary, element of their training; but except to the few who were so constituted that with little or no guidance they could supplement their practical knowledge with the study of principles elsewhere, it was entirely ineffectual in the production of that well balanced attitude of mind which any person who properly assumes the name of an engineer must hold toward every engineering problem, great or small, which he is called upon to solve. And so strongly have I felt this, that in the earlier days, when there were fewer schools of practical science, and when their utility was little understood, I required, wherever the matter was under my control, the insertion into the articles of apprenticeship of a clause by which, at some inconvenience to the office, the pupil was required to attend two sessions at the science classes of Glasgow University, or at some other approved school of practical science; and without this condition I declined to take the responsibility attaching to the introduction into the profession of men who, in their earlier careers, from no fault of their own, had not even acquired a knowledge of what there was to learn, much less of how to learn it. More recently this course has become generally unnecessary, for in Westminster at least the young engineer rarely enters an office until he has acquired some knowledge of what he has to learn. He enters, in short, at a much more advanced age than formerly. When it is essential that he should be earning something soon after he comes of age, anything like a complete training is an impossibility; his work ceases to be general, and his practice is more or less confined in a much narrower sphere than need be the case if the pursuit of further knowledge continues to be his chief duty. It is not desirable, at least so it appears to me, that even at this stage his training should be specialized in view of the particular branch of the profession or business he is likely to follow. The fundamental principles of any branch of mechanical engineering are broadly the fundamental principles of any branch of the profession.

In America I understand that a college course of engineering generally includes workshop practice designed to supersede the old system of apprenticeship to a mechanical engineer. This fact and other important differences between the English and American practice have only lately come to my knowledge, and before they did so the substance of this address had been written. It might, in some particulars, require modification as applied to Canada, but it remains the result of my observations concerning the conditions of engineering education which obtain in the mother country. A few words now in relation to that physical and mental training gained laboriously, and somewhat wastefully as I think, at the joiner's bench, in the fitting and turning shops, the foundry and the forge, during the old course of mechanical engineering apprenticeship. I am convinced that the kind of knowledge which comes of thoughtful chipping and filing and turning and forging, though only applied to a few of the materials with which, in after life, the engineer has to deal, are quite as important as tables of density and strength to his future sense of rightness in constructive design. The use of such work is not merely to teach one the parts and combinations of any particular machine; in a still higher degree it is the insensible mastery of a much more subtle knowledge or mental power, the application of the senses of sight and touch and force, it may be of other senses also, to the determination of the nature of things.

The compulsory inclusion of the principles of all such subjects as chemistry, electricity, geology, and many others, in science courses intended for a future engineer is desirable, not only because a fundamental knowledge of them leaves open a very much wider field from which the engineer may, as opportunity offers, increase his knowledge and practice in the future, but because many of such subjects are inseparable from an intelligent understanding of almost any great engineering work. "Nothing so difficult as a beginning" may be a proverb of rather too far reaching a nature, but it contains the suggestion of a great truth, increasing in weight as we grow older, and the beginnings of such collateral sciences should therefore find a place in every engineering student's store of early knowledge.

AUTOMATIC EXTINCTION OF LAMPS.

AN ingenious arrangement of street lighting, which allows a reduction of the illumination at any time when less light is needed, is described in the Electrical Review. This arrangement is now in use in several places, but Portsmouth, England, is considered a notable instance, as the system has been successful there. It appears to be a system of automatic switches. "The automatic switch, which is being used on 240 lamp posts, is designed so that, when the arc lamps are turned off, the incandescent lamps are automatically lighted." It ought to be explained that each lamp pillar has an arc lamp as well as two incandescent lamps, the latter being employed during the period when the lesser illumination is desired. "The device consists of a coil in series with the arc light, and, when the arc lights are burning, the coil becomes energized and attracts the end of a lever; when, however, the arc lamps are extinguished, the rocking arm drops down upon a knife edged switch, and this action has the effect of completing the incandescent circuit, thereby turning on the glow lamps." The paper quoted illustrates this arrangement by engravings which cannot here be reproduced.

The operation, however, is so simple that its general features may be understood without engravings. When the lever spoken of drops, the incandescent circuit is completed, the current passing through a tube straight to the lamps, returning to the switch through the arm of the lever and out again. This provides for the lighting of the glow lamps at the instant of extinguishing the arc light. The extinguishing of the incandescent lamps, in their turn, is accomplished by sending a reverse current through the arc lamps, and consequently through the coil, thus lifting the lever out of the switch and cutting out the incandescent lamps. To prevent the lever from falling back again into the switch, a permanent magnet is pivoted under the solenoid in such a manner that it may move horizontally. This magnet carries a catch, which, passing under the arm of the lever, holds it from falling back on to the switch when the current through the series coil is interrupted, while, at the same time, it permits the core of the solenoid to drop down to its original position. To insure that the lamps are all effectually cut out, the reverse current is turned on for about five minutes. When the current for the arc lights is sent through the lamps, the pivoted magnet which operates the catch is drawn back into its original position, which leaves the lever free to act, according as the coil is magnetized or demagnetized. The use of this apparatus in Portsmouth is estimated to have saved the wages of three men.

"In view of the continually increasing employment of iron in building construction," says the Revue Technique, "it is well not to lose sight of the disastrous action exerted by lime and plaster of Paris on this metal. If we plunge pieces of iron into a vessel of freshly prepared lime, a rapid oxidation takes place, especially if wrought iron or laminated iron is used. This oxidation is not confined to the surface, but rapidly reaches the heart of the iron, which in a very short time undergoes a profound alteration in resisting qualities. To this must be added the great expansion caused by increase of volume of the mass. It has been shown thus that iron frames put together solidly by means of clamps were nevertheless broken. The action of plaster of Paris is similar. On the other hand, cement seems to be an excellent preservative against rust, and it has been shown that pieces of iron covered with a thin layer of cement remained unaltered after being for a considerable time under water. It would even seem that such a covering is preferable to painting with red lead."

The perfect construction of a bicycle wheel so as to obtain an equal degree of tension upon each of the spokes is a matter of no little difficulty when it is computed that a single turn of the nut holding the end of a spoke in the rim may make a difference in the pull of some 50 lb. or 60 lb. and leave a very slight margin of safety, if any. From a highly interesting article on the subject contributed to our contemporary the Engineering News, we find that the results of tests proved a difference in the tension of high grade bicycle wheel spokes of as much as 100 per cent. between extremes. Presumably this great difference is the result of the employment of wood rims, which are almost universal in the United States, but it emphasizes very clearly the advantage derived from the use of the pneumatic tire in taking up shocks due to the unevenness of roads.

HEATING AND VENTILATION BY MOISTENED AIR IN SPINNING MILLS.

PORTER & LEWIS APPARATUS.—In this (Fig. 1) we find the funnels, set one into another, of the Roger Pye apparatus. Four apparatus of the same kind are usually arranged around the same center at which the steam pipe ends. This is clearly shown in Figs. 2 and

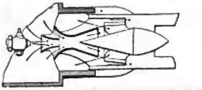


FIG. 1.—PORTER & LEWIS APPARATUS FOR MOISTENING AIR.

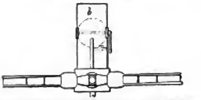


FIG. 2.—APPARATUS WITH FOUR ATOMIZERS.

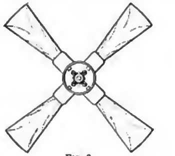


FIG. 3.

3, the former of which shows in addition the tube through which the cool air enters under the control of the register, b.

The Tattersall Apparatus.—The air under pressure is admitted through the large central conduit, a section of which is seen in Figs. 4 and 5, while the water circulates in the pipe situated immediately beneath the preceding. The two fluids make their exit through their respective ajutages, and the two jets, in crossing each other and in impinging against the screen placed opposite the air ajutage, become mixed. The air of the

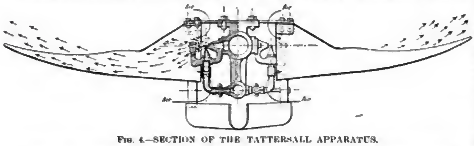


FIG. 4.—SECTION OF THE TATTERSALL APPARATUS.

room, sucked by the gaseous current, becomes also mixed with them. The whole makes its exit through inclined nozzles. The water in excess is collected by the pipe situated at the lower part of the apparatus.

The Josephy Apparatus.—The water enters the revolving funnel, h (Fig. 6), and participates in its motion. The centrifugal speed which is thus given it projects it through a circular felt filter, b, into the drum, f. Here it meets with the current of air sucked in at o by the exhauster, d, which carries it along and causes it to make its exit from the apparatus in the direction shown by the arrows. But all that is carried along is the fine drops of water. The too large drops, which are thrown into the drum, f, impinge against its wall, and, along the latter, descend into the tank that is formed by the base of the drum, and that is connected with piping which leads the water in excess to the exterior. If the mist carried along by the current of ascending air contains dust, this is projected against

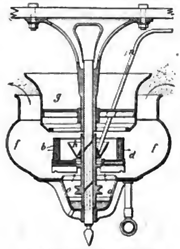


FIG. 6.—JOSEPHY APPARATUS.

the vessel, g, moves along its walls and falls into the tank, so that a fine vapor is alone sent into the surrounding air. The pulley that drives the apparatus is situated to the right of the orifices, o.—Revue Industrielle.

THE CONTROL OF FIRE.*

IT ought to be of special interest to correctly define the work of professional firemen. The term fire extinguishment, which is supposed to describe the work performed by our fire departments, conveys no adequate idea of the duties and responsibilities incident to the modern conditions of fire duty. For that reason I have, as on an occasion hitherto, preferred to designate all the duties of a fireman as those which have to do with the control of fire. The control of fire signifies all that we commonly ascribe to fire extinguishment and a great deal more. The uncertain attempts at fire extinguishment practiced by any one under the exigencies and the circumstances that surround the occurrence of fire, where there exists no regularly organized body of men maintained solely for the purpose of extinguishing them, separate the field of fire extinguishment, so called, from the strict application of the control of fire exercised by proficient firemen with the efficient apparatus, and by a body of men who are under constant discipline, and engaged exclusively and constantly for this duty and service. It is within a recent period of time that the control of fire has animated and guided the operations of our fire officials. Previous to the year 1865 the conditions and limitations under which firemen performed their duties forbade the present successful results, and the judgment of experienced firemen in many of our volunteer fire departments, aided by an earnest and willing corps of men, could not prevail against losses due to inefficient apparatus, a lack of discipline, and other features which combined against successful results. The elements that have contributed signally to the advance of the control of fire were a trinity of causes operating simultaneously, and from the beginning of which I date the modern period of fire extinguishment. I refer to the installation and usage of electricity in connection with the fire service, to transmit alarms of fire, and especially through the installation in its best form of the fire alarm box, permitting ready communication and announcements of fires to be communicated instantly, and giving a reasonably definite location of such fires.

Second, to the introduction of the steam fire engine, and then, as a third cause, the establishment and maintenance of a regularly organized fire department, supported entirely by the municipality, and engaged wholly and constantly in the fire service. It is perhaps within bounds to say that the establishment of a paid department, which really means the engagement and constant service of a body of men trained and skilled in the art of fire extinguishment, has done more to advance this service, and in every way has worked for the surer and readier control of fire, than all other causes. It is clear that this must forever remain so, for no apparatus, however powerful, or no other conditions can be successful, unless, after all, the work is intrusted to a body of men whose judgment, experience and skill will produce the results which these inanimate helps toward fire extinguishment are capable of rendering. It is true there are other reasons, which contribute to and supplement those mentioned, in enabling the firemen to attain a readier control of fire. Well paved streets, an efficient police department, abundant water supply, adequate width of streets, building regulations, defining materials allowable for use, and giving rules pertaining to construction, and many other matters, have an important influence upon fires. The precise thing which I mean by control of fire is its mastery with the smallest amount of loss, not money loss, since fire has no measurable sense for the purpose I mean, but the least loss of that material which may be in process of burning, and its control in the minimum of time; in other words, the least loss of what was liable to be consumed, and its extinguishment in the least measure of time. The successful control of fire carries with it the responsibility, intelligence, ability, judgment, skill and experience which will enable a fireman upon arriving at a fire to definitely and instantly conclude where his point of control will be. Of course, it is a question of contention whether fires at certain stages are controllable.

It is certain that in our larger cities the whole building art is changing to an extent that requires a readier control than has ever been exercised to prevent a calamitous fire. The height and character of the structures of prevailing type, of steel frame construction, with such immense window and light area, makes such buildings far more subject to fire externally than is commonly supposed. They are far more susceptible to fire from exposure than many inferior buildings, and the extent of a fire within them, if once communicated to them, depends largely upon the character of their contents. To understand the application of the rules for the control of fire, I would classify the risks of fire in this manner. First: The contents risk, being the fire liable to the contents of a structure. Second: Structural risk, being such fires originating in or about the building or a part of the same, as distinct from the contents. Third: The exposure risk, those fires carried by communication from the original seat of fire to other structures. I would class the conditions under which the different kinds of fire occur as follows: First: Cities densely built. Second: Towns, cities and villages, where one or two streets are densely built, and the balance of the community contains structures fairly isolated from each other. Third: Villages, containing risks sufficiently isolated from each other. Fourth: Completely isolated structures, such as manufacturing plants, asylums, hospitals, and all classes of structures built at such a distance from any other structure that in no event can they communicate fire elsewhere. It is self-evident from this classification that cities and towns must provide proper means for the ready control of fire. It is important to know what agencies exist for the control of fire other than the fire departments. The use of the sprinkler systems, which is nothing else than a local water supply in a structure, which is automatically brought into operation when a certain degree of heat is attained, is an important factor in the prevention of serious fires. The increasing efficiency of the sprinkler systems in the protection of buildings, and their contents, from loss, and the automatic extinguishment of fires through their agency, is a feature of distinct economic influence; it is especially so in the case of isolated plants, and is the best single means of protection that can be afforded. Its auxiliary work for firemen is of no less importance, and the frequency with which fires have been held in check, and remained within the control and easy extinguishment by firemen upon their arrival, makes the use of sprinkler plants a matter of much consideration in the protection of structures in our larger cities, irrespective of the excellence or proficiency of the departments therein.

The maintenance of special and direct wires to buildings to communicate alarms of fire facilitates the work of the department, and this feature of the use of the telegraph system is growing. Stationary fire appliances have not secured the respect of professional firemen. I believe that the largest cause of failure in stationary appliances is due less to the appliances themselves than to the fact that it is expected to use them efficiently with untrained help, and without having them under that regular inspection and preparation which is essential for all appliances that relate to fire. I think that the stationary fire appliances, without reasonably efficient and trained help to use them, will remain, therefore, of uncertain value, if not of actual detriment in the attempt to control fire.

The importance of locating a fire is one that strikes the mind of every experienced fireman instantly; and no fireman can claim thorough competency, unless he acquires and trains himself to the knowledge or art of discovering the exact location of a fire. This is his first main reliance toward the actual control. I trust no one will imagine that he is to look for the starting point of a fire if, upon his arrival, he finds the building on fire from cellar to roof. It certainly must be clear to all of you how essential it is, in order to secure the

* An address delivered by Simon Brentano, at the twenty-fifth convention of the International Association of Fire Engineers, held at New Haven, Conn., August 17-20, 1897.

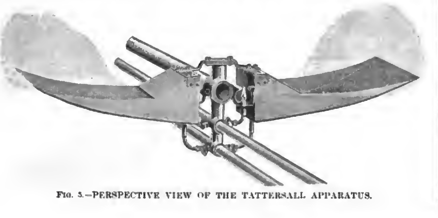


FIG. 5.—PERSPECTIVE VIEW OF THE TATTERSALL APPARATUS.

best results, to be able to promptly locate fires. The next object in the control of fire is the proper location of companies, and assignment of officers and men. It is not my purpose to go into details and describe the operations of a fire. My main point is to establish that the rules for the control of fire must be uppermost in the mind of any one who hopes to achieve success in this direction. Some men who are successful, but who have never analyzed their methods or operations at a fire, assume that no thought or reflection is necessary. These men are fortunate in the sense that they generally exercise a correct and instant judgment, but, notwithstanding their apparent lack of deliberation, their plans and conclusions, no matter how quickly formed, are subject to a careful analysis. The danger existing in every fire, however minute, is the generation of heat and gas. It is a matter of the highest importance to remember that the process of combustion at fires causes an abnormal condition of the air surrounding the fire. The air certainly becomes changed by being charged with the heat and gases of combustion. It takes on altogether different qualities, and what these exact qualities are, and how they differ at different fires, is as yet unknown to anybody. From observations made at numerous fires, I am convinced that the atmosphere at certain stages of a fire, and especially certain parts of it, is transformed into a combustible and explosive gas, and I believe that this air is a means of actual communication of fire. By a school of writers on this subject, who have made some observations, it is believed that the air or gas is caused in a large measure, if not entirely, by reason of the water used for the purpose of extinguishment being decomposed into its original elements of oxygen and hydrogen, and that the hydrogen is the agency which communicates the spread of fire. I am convinced, on the other hand, that in the entire absence of water, this superheated air or gas accumulates, and is a dangerous agent in the dissemination of fire, and the longer a fire remains without control, the larger the quantity of air that becomes heated in this manner. Indeed, the danger of destruction to any considerable area arises in my mind from this source, since the communication of fire through this means is far more rapid than can be the control over the new territory which it has invaded; hence the extreme danger from this cause. In every fire the gas or superheated air is generated to a certain amount, and you all have experienced this, perhaps, and some of its manifestations. These consist of back draughts, the raising of roofs, the explosions in buildings, with sudden collapse, and even the superheating of air in the buildings adjoining those on fire, causing explosions, and often resulting in fire. Nothing is more essential to the control of fire than the elimination, so much as may be possible, of the chances for the accumulation of large bodies of this air or gas. Of course, the earlier a fire is controlled, the less opportunity exists for its formation.

On the subject of the control of fire, I shall now repeat, in part, the matter which I have used in a paper read before the Massachusetts State convention.

It is the modern fireman who was instrumental in affording the means and devising the methods whereby a fire is controlled. The old methods believed a fire destined to have its own way unchecked. The modern system has for its object, and succeeds in most instances, indeed, in the great majority of cases, in keeping a fire within reasonable control. What do we actually mean by the control of a fire? I define the control of a fire to mean its restriction as nearly as may be possible, under the varying circumstances attendant upon and surrounding each fire, to the actual point of origin, or to keep it within that boundary which the fire has attained at the time of the arrival of apparatus. In some instances this means that the fire will be confined to the room and to the actual incipient blaze which ignited a window curtain; in others, it will mean the complete destruction of the building in which the fire originated; again, in others, it may mean the ignition and destruction of neighboring and adjacent buildings. But at no time has the experienced fireman lost his sense of control, nor have his plans changed, except by reason of those changes forced upon him by the apparent gain of the fire over all control for the time being. But in such cases companies are assigned to new positions, the lessening points of danger abandoned, the more menacing positions strengthened, and that disposition is made in detail that evinces the sagacity, the quick and ripened judgment of the fireman, and that throughout illustrates the underlying object to be achieved, namely, the control of fire. Against what fearful odds the control is often won is familiar to you all. It must often have impressed itself upon your minds, reflecting on the changing conditions that have existed during the course of some of the fires at which you have performed duty, how the careful assignment of one company may have been the key point, or in other words, determined the control of fire. The control of fire should not at any time be confused with the actual extinguishment of fire. I have seen fires far more destructive than the occasion warranted, by reason of the fact that the proper estimate was not placed upon the chief element attaching to every fire, namely, a correct judgment as to its control. To illustrate this by familiar example, I need only point out that many fires gain and cover an area larger than they should, because upon arrival the companies, or those in charge of them, fail to recognize that the original point of fire is beyond instant control, but in the mistaken effort to extinguish this original source of fire, instead of keeping it in check, it permits the fire to extend.

The inability to view a fire and to determine at once whether or not the greater effort should not be extended to surrounding risks rather than the immediate fire itself, forms one of those errors of judgment in practice which has been, and will continue to be, a serious cause of unnecessary fire loss. Of course the control of a fire, I need not say, should be effected with the greatest celerity possible. It is, of course, a simple and fundamental law of fire extinguishment that the danger of destruction is lessened with each moment gained in the control. Most fires attain their maximum in relatively short time. I have timed several very serious fires, and I have estimated that they have reached their maximum danger point in thirty five to fifty minutes. After that time the fire was a receding one; that is to say, the control over it was becoming manifest. A fire which, one hour after its inception, is burning as fiercely or as dangerously, and shows no sign of abatement, is a most serious fire, and portends great danger. Of course, I except from this classification structures completely isolated, certain oil fires and lumber fires, but in the main the visible signs of gain should be present in thirty-five to fifty minutes. I have seen a very dangerous fire in a five story building, about 50 × 75 feet, where the fire originated on the third floor, and at once assumed large proportions, controlled in exactly fourteen minutes, although the actual duty of fire extinguishment kept a sufficient number of companies busy for five hours subsequently. The great Bleecker Street fire in New York, which I consider to have been one of the most dangerous fires that have occurred in that city, reached its greatest danger point in forty minutes after the first alarm had been sent out. After that period of time, further danger to surrounding property was passed. If you will accustom yourselves to make some calculations as to the time of control of most fires, I am sure you will often be surprised at the quick mastering of the maximum danger. I again repeat my injunction to separate in your thoughts the method of control, and the attainment of its object, from the mere act of fire extinguishment. In many fires the matter of control and extinguishment are performed simultaneously. In many and in most serious fires the control of a fire, of course, precedes its extinguishment.

I will now allude to another simple law in fire extinguishment. It has no merit of novelty, but it has the distinct advantage of being permanently associated with any successful achievement in fire practice. The rule is one perhaps sufficiently known. It is this: Bring your water to bear as near as possible to the actual seat of fire or seat of combustion, if you expect the most successful results. It requires a specific amount of water to destroy the heat units generated by combustion; the exact amount of water to apply is, and must remain, an unknown quantity, because different kinds of fires develop different degrees of heat or develop a more intense flame at certain stages of the fire, then often the heat units at one point of a fire are enormously intensified when compared to other portions of the same fire. Accordingly, in the actual practice of fire extinguishment there is a great loss in the economical use of water, since no standard can be fixed which will make a working rule. The most efficient use of water is attained when the stream is directed at a range as close as practical conditions permit to the actual seat of fire. The waste of water is less blamable than the waste of a company's strength, which fail to use their stream or direct it to that part of a fire where it will do the most efficient service. Firemen often continue to play upon certain portions of a fire not reaching the vital part at all, or what is equally faulty, will maintain their stream constantly in the same position, when the condition which has warranted that position has passed away, and when they should have passed away with it to another point. Firemen should be reminded that a stream of water will not yet readily penetrate solid brick walls, and that every attempt should be made from the first second in taking position to make their streams effective, and to see that streams are not interrupted in their course. In this connection I allude to another law of fire extinguishment, familiar to all, that the efficiency of a fire stream is dependent in a large measure upon its volume and force; these two elements together constitute the highest efficiency of fire streams, not alone its volume, but its force of penetration. The particular reason, and there exists one, why the quality of force or pressure, as we denominate it, should have such an important influence in extinguishing fire, I am not yet prepared to assign. I do think that certain great and influencing results follow from a stream being directed with pressure, which do not take place when the same volume of water is used without that pressure. Firemen should familiarize themselves with the proper size of nozzles to use with certain pressure, and have at all times ready command of that knowledge which will enable them to secure efficient streams.

I now come again to an important point essential in the primary education of every fireman. I refer to the ability to promptly locate a fire. The term "locating a fire" means in this sense the requisite and immediate knowledge to ascertain the actual point of a fire in structures where a fire is burning, but of which the actual seat is not easily discoverable, or has not made itself manifest. We are familiar with the many fine fires traveling away from the starting point and revealing themselves so far from the fire that, unless skillful judgment is used, and quick work accomplished, the fire may appear to be extinguished, and yet the actual cause and greater fire remain unextinguished. The same suggestion applies to other fires, when buildings are heavily charged with smoke and heated gases, and where it is almost useless and indeed dangerous to start a stream until a fire has been located. The miscellaneous crowding of companies into a charged building before a fire is located is bad fire practice, and unnecessarily jeopardizes the safety of the men.

I shall touch briefly a recent development which I have noticed with some regret, and which, I believe, can with propriety be mentioned here. I allude to the greatly improved apparatus and implements which are coming into the service of firemen, but which, unfortunately, have imbued some firemen with the idea that they need never use their own brains hereafter. To those firemen relying so largely upon apparatus instead of their own minds for successful work, it is only necessary to remark that the appliances, after all, cannot supplant or make up the deficiency in human intellect.

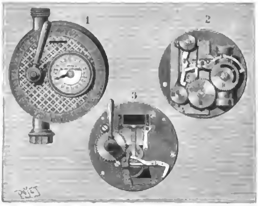
In expecting to exercise a control of fire, every fire official must bear in mind, according to the department with which he is connected, the hazard and menace which a community can be exposed to, when two or more fires occur concurrently. His provision for assignment of companies, and for the prompt relief and return of companies to quarters if not absolutely necessary at a fire, should be constantly before him.

Upon the safe protection, immunity from and ready control of fires depend the prosperity, the importance, and the happiness of a community, as much as it does upon any other department of the municipal service. Surely this will be conceded upon a little reflection.

While extending protection against fire, and aiming at the better and quicker control of fire, it is no less the duty of the fireman charged with such responsibilities to persistently, honestly, and fearlessly awaken and maintain a public interest in all that relates to his art, to the end that sufficient means are placed at his disposition to enable him to perform his duties, and to enlighten the public mind to the fact that the work of a fireman is one requiring the exercise of correct judgment, experience, skill, and other attributes, and withal a combination of such qualities that forbid the appointment or engagement of men in any capacity in our fire departments, unless they possess the qualities demanded. This is a duty that firemen owe to themselves, to their communities, and to the public at large.

THE AUTOMATIC GAS DISTRIBUTER.

THE Hour automatic gas distributer represented herewith is really a meter, but one that allows only a definite quantity of gas to flow, corresponding to the value of the coin for which it is constructed. The occasional purchaser who, through his franc or fifty centime piece, has acquired the right to burn that much money's worth of gas, regulates his consumption at his will and lights or extinguishes the gas whenever he chooses. It is possible for him at any instant to read upon a dial divided into fractions equivalent to five centimeters' worth of gas what remains for him to use.



AUTOMATIC GAS DISTRIBUTER.

As for the operation of the apparatus, that is very simple. As long as no coin has been introduced into it, the external handle is loose and disconnected with the cock that allows the gas to flow. In order that the would-be consumer may obtain a supply of gas, it is necessary for him to insert a coin of the requisite value into a slot provided for the purpose. The coin, in falling upon the lever, L, Fig. 3, depresses the latter and establishes the necessary connection between the cock and the handle. All that the consumer then has to do is to turn the latter in order to open the former. But, while doing this, he sets a spring, which, as soon as the quantity of gas paid for has made its exit, will suddenly interrupt the junction and close the cock automatically.

The simple opening of the cock suffices likewise to wind up and set a small clockwork movement in operation. A cam, C, Fig. 2, is carried along by the movement, and after finishing its revolution, frees the spring just as the last of the quantity of gas paid for is flowing out. At the same time, the coin falls into a drawer in which the receipts are stored. The lever, L, rises, and all interdependence between the handle and the cock ceases.

As may be imagined, the rotary speed of the cam must at every instant be proportional to the quantity of gas that flows out, and consequently, to the opening of the cock. This is regulated and the necessary acceleration or retardation of the clockwork movement is produced by automatically modifying the length of the pendulum. To this effect, the bob, H, of the latter slides upon its rod, thanks to a small chain from which it is suspended and that is carried along by a sector, S, pivoting upon the shell of the cock.—La Nature.

The Hungarian government has completed the necessary arrangements for the construction, without delay, of a subway beneath the Danube at Budapest on the same principle as that of the new Blackwall tunnel under the Thames in London.

SUBMARINE TELEGRAPHY—A NEW FRENCH TRANSATLANTIC CABLE.

By HENRY HAYNIE, in Boston Herald.

ANOTHER transatlantic cable is being laid from France to the United States, and very soon the French company will have two lines running under the ocean from the village of Orleans, Mass., on old Cape Cod to the city of Brest in ancient Brittany. It is not every one who can remember the earliest days of Atlantic telegraphy, that is to say, when a cable was laid from the shores of Newfoundland to the coast of Ireland, and when President Buchanan exchanged messages with Queen Victoria.

In 1879 the French republic, or rather M. Pouyer-Quertier and his friends, wanted an Atlantic cable to "secure the telegraphic independence of France," as another one, laid some time before from Brest, though undertaken on the principle of competition, had been absorbed by the Anglo-American. M. Pouyer-Quertier was minister of finance under President Thiers, and he played a prominent part in arranging for the indemnity of several billions of francs paid to Germany. Continental capitalists backed up the enterprise eagerly, but the English opposed it energetically. That French cable was landed first at St. Pierre, a matter of some 2,400 miles from Brest, and was thence continued for a distance of 850 miles more to the east shore of Cape Cod, in Eastham, and an office of transmission was established there. But two or three years back the station was moved to Orleans.

Some 1,223 separate and distinct cables, aggregating a total of nearly 185,000 miles, have been laid throughout the world in less than fifty years, at a cost of at least $165,000,000. However, we hardly ever think of the "thousand and one" submarine lines that cross coves, bays, estuaries, wide rivers, seas between islands, etc.; when we happen to speak of cables, we usually mean the great Atlantic system of telegraphy. Great Britain owns most of the great cables, operating fourteen long ocean cables, nine of which belong exclusively to her; in the Indias she owns ninety three, and has a part ownership in five more; her home system includes 102 separate lines; and in her colonies there are forty-five, making a total of 260 cables. France operates sixty-five separate ocean cables, many of them the most important in existence. One of these is the French cable, as it is familiarly called, that has been working from old Brittany to old Cape Cod these eighteen years. Germany has forty-five cables, but they are short in comparison with those of England or France. Italy has thirty-eight. There are more cables in Sweden-Norway than in any other country, but they are all very short ones.

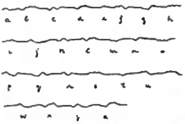
A new board of directors, under the management of M. Depelley, determined a short while back to improve the French Cable Company's facilities by reinforcing their old cable by another, and it is this new one which is now being laid. It is made up with the largest conductor ever yet laid to the United States, and it will be completed before the dead leaves finish falling. It will parallel the route of the old French cable, but so large are the dimensions of the core conveying the current that it is expected the message from France can be freely read off the siphon recorder here in Orleans without having to be written down and retransmitted at St. Pierre. The size of this coil is 700 or 800 pounds to the mile, independent of the gutta percha insulation, the manila covering and the further covering of large steel wires to protect it from material injury. To lay such a cable requires a steamer of extraordinary dimensions equipped with all kinds of electrical apparatus, as well as the most approved gearing and machinery. So the French company secured the steamship Silvertown. She is 350 feet long, 55 feet broad, 34 feet in depth, is fitted with engines of 1,800 I. H. P., and steams 10½ knots an hour, with a consumption of 30 tons of coal daily. She carries three tanks, each being 32 feet deep, and the largest is 58 feet in diameter. This tank has, consequently, over 70,000 cubic feet capacity.

When carrying 6,390 tons, the draught of the Silvertown is 28 feet. The coal bunkers have a capacity of 1,300 tons, besides which 1,000 tons of fuel can be stowed in the forehold. She has taken on board at one time as much as 2,160 knots of ocean cable. But a cable of the proportions now being laid down by the French company calls for three or four trips to complete the work. When the Silvertown pays out all the cable on board, her crew attach the end to a buoy and drop it overboard. Then she steams back to France, where the cable is made, takes on a further supply, returns to this buoy, takes up the end, makes a splice to it and so continues the work until the cable is entirely laid from Brest to Orleans.

The story of how a lost cable or a non-working one is picked up in midocean has been told repeatedly in newspapers and in magazines, but not so of the scene in a coast station where operators have to wait patiently and may be a long time for new connection with the office at the thither side of the Atlantic. The last important break in the French cable occurred last October, and it produced a delay of three weeks. "Day after day, night after night, through several weeks," said an operator to me, "one of us was always on duty watching and listening until sight and hearing were almost gone. Thrice every day and twice every night the wire was tested, not with any expectation of a message from our comrade on the steamer—it was not yet time for that—but simply to keep an accurate record of the condition of the cable. Sometimes wild messages seemed to be coming from the deep, extraordinary cablegrams in a language of gibberish that was wholly incoherent, but these were merely the results of magnetic storms and earth currents which reflected the galvanometer rapidly or jerked it to flash sentences that were nonsense. Then one morning at the end of three weeks the operator on duty observed a peculiar indication about the instrument which showed his experienced eye that a message was at hand, and in a few moments we were in communication with midocean."

The French Cable Company is represented in the United States by Mr. M. Laricenne, at New York, while the superintendent or manager of the Orleans station is Mr. H. Osborne, an Englishman, who learned how to telegraph when a mere boy in his first school days. The present writer is indebted to the latter for much valuable information. At the time of one of my visits to his office a cablegram from Father Neptune was received and handed to me. It is reproduced on this page precisely as it was traced by a curiously shaped glass pen worked by a delicate galvanometer on "the tape" or white paper string about three-quarters of an inch in width.

The cable men handle all the cable work, and there is a countercheck or record kept of all their work by the land wire men. The cable pen waves off a message, and above the line of curious looking ups and downs and curves which a delicately poised indicator traces stretches another line of words, but their lettering is broken into dots and dashes. This upper line is written by the Morse system of telegraphy, the lower or real cablegram is woven by a curiously shaped thing of hol-

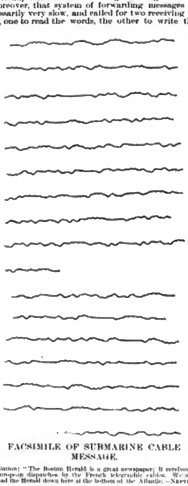


THE SUBMARINE TELEGRAPH ALPHABET.

low glass, through which flows a dark liquid, and the pen is caused to move or waver by the feeble electric current passing the galvanometer at the right hand of the operator. This instrument, the invention of Sir William Thomson (now Lord Kelvin), took the place of the much talked of and written of spark or flash telegraphy some time back.

I do not know whether any of my readers have seen in practice that old fashioned mirror system of cabling, as it was called, by which they communicated formerly across the Atlantic. If they ever visit a cable station I strongly recommend them, as a matter of curiosity, to see it, if possible, for, though no longer in use, I dare say the manager will have it in storage somewhere about the office. It is one of the most ingenious pieces of machinery that I have ever beheld, even if it is obsolete. It involved this: The continual watching of a small speck of light reflected from a tiny mirror and traveling over a diagram representing words or letters of the alphabet or something of that sort. Naturally, the strain on the eyesight was immense; it was so great, in fact, that after some years' exercise of it a man became almost absolutely incapable of turning his attention to any other mode of earning his living.

Moreover, that system of forwarding messages was necessarily very slow, and called for two receiving persons, one to read the words, the other to write them



FACSIMILE OF SUBMARINE CABLE MESSAGE.

Translation: "The Boston Herald is a great newspaper; it receives long European dispatches by the French telegraphic cables. We always read the Herald down here at the bottom of the Atlantic.—NEPTUNE."

down as called out to him. The companies, as well as the operators, were glad, therefore, when Sir William's invention enabled them to make use of the present system. If Morse signals could be sent by sound under the Atlantic, transmission of dispatches would be made more quickly and of course at less expense than is now the case. When the first submarine cable was laid under the ocean such sounds did work feebly through the line at the rate of about three words a minute, I believe, but that was altogether too slow, and was uncertain; so another method had to be invented. Thus came into existence what was known as mirror and flashlight system, just now spoken of. While it worked much more swiftly than the Morse, it could do no more than twelve to fifteen words a minute. This slowness impelled inventors to devise something else, and finally Sir William Thomson got up the present system, which is good for forty to forty-five words a minute. But attention is being constantly directed toward the utilization of sound signals by cable companies, and success will probably come eventually, though it is not yet in sight by any means.

Messages have been sent thousands on thousands of miles with wonderful swiftness. For instance, the London Globe of March 23, 1893, printed the following paragraph: "The result of the university boat race was telegraphed and received in New York three seconds after the result was known at Mortlake. This was accomplished by the French Atlantic Cable Company, and is one of the smartest telegraphic feats on record."

At the time of our presidential election in 1892 an English newspaper published in Kobe, Japan, wanted the result as soon as known in New York, and the editor arranged by correspondence with the manager in America of the French cable to forward the same as swiftly as possible. I may say that when it is midnight in New York it is only 2:15 o'clock of an afternoon at Kobe. Well, at midnight of the day of election these four words: "Herald, Kobe, Japan, Cleveland," were started from the office in Gotham. They went to Cape Cod, thence to St. Pierre, thence to Brest, thence to Paris, thence across the continent of Europe, under the Mediterranean to Africa, under the Red Sea to Asia, then through India and China, under the Sea of China to Yokohama, from which place they were telegraphed by land wires to Kobe, where they were handed to the editor, who at once put the Herald with the important news to press, and an "extra" was selling in the streets of Kobe at 4:30 o'clock. Precisely two hours and fifteen minutes had elapsed since that dispatch left New York, and I daresay as much time was consumed in getting it from Yokohama to Kobe, setting it up in type, and printing it as there was in transmitting it from the United States to Japan.

It is not so very far from here to Boston, straightaway, but as yet cablegrams from Europe addressed to your city are not sent directly there. In the summer of 1895, while in Portland, Me., I had occasion to send a telegram to Bar Harbor, some distance to the east-northeast from that place. When the message was handed in and paid for, the gossiping clerk said it would have to be sent to Boston first before it started on its way to Bar Harbor. This, I thought then, was quite a "roundabout way" of reaching that resort; but it was a mere nothing as compared with the flight of a telegram from Orleans to Boston. All messages from Europe are distributed only from the New York office, so I was informed at the cable station. It is the intention to open a cable office in Boston soon, and before this is done a land wire will be constructed from this village to the capital of the commonwealth; meanwhile all dispatches must go to the metropolis. We will suppose that Ambassador Porter wants to communicate with the editor of the Boston Herald. He files his message in one of the many telegraph bureaus that are scattered over Paris, and it starts on its long voyage straightaway to America. The course is due westward to the island of St. Pierre-et-Miquelon, off Newfoundland—owned by the French republic; but thence the submarine cable runs southerly to Cape Cod and finally reaches Orleans, about 65 miles from Boston in a direct course. Received there and recorded, the diplomatic communication to our fourth estate is not, however, sent directly on to its destination. Instead, it takes its way the whole length of Cape Cod to the mainland of Massachusetts, goes out of that State into Rhode Island; out of that and into Connecticut; thence into New York State beyond Stamford, and, by and by, reaches the island of Manhattan, where another record and transfer are made of the message. This done, it is "rushed" toward Boston. Again it travels in four States, and finally, after having been flashed along something like 500 miles of land wire since it came ashore at Orleans, it reaches its destination in the Boston Herald building.

This "circumlocution" and its attendant delay, not to mention the annoyance of being thus compelled to be subordinate to Gotham, will disappear altogether when the French company opens its Boston office, and enters into competition with the Commercial, the Western Union, the Anglo-American, the Direct and all the other lines. For though the rates are precisely the same on all of them from Boston to Paris or to London, there is competitive rivalry, and business is keenly sought for by each company. Said the manager:

"Though I cannot reveal to you any details in the commercial transactions of this company, I may state that our traffic has not materially suffered from the recent business depression, and I think we have had a fair share of the messages between America and Europe, both ways. Our precise percentage of the entire traffic as compared with the percentage of it which the Anglo or some other company secured is an office secret, but I repeat we have no reason to complain; quite the contrary, in fact. When the new cable is down, when we have our own office in Boston, and a land wire thence to this station, our share of the whole will be considerably increased, while the public and the press will have a much better service than ever."

The first charge for messages through the Atlantic cable, from New York to London, or vice versa, was $100 for 20 words; this rate was reduced after some time to $50 for 10 words, and by 1875 the tariff had got down to $1 a word. A new company completed a cable in 1875, and then a rate of 75 cents a word was established. The French Cable Company—Le Compagnie Francaise du Telegraphe de Paris à New York—landed its cable on the shore of Cape Cod in 1879, and effected a reduction of tariff to 50 cents; it is now 25 cents a word to either London or Paris.

But the cost of cabling a dispatch to some place in Japan or China, or, indeed, to any country on the western coast of the Pacific Ocean, would be very great. The message would have to be sent over 3,000 miles due east before it could commence feeling its way toward Japan or Australia. Such a dispatch sent from San Francisco would have to cross the American continent,

the Atlantic Ocean, Europe, a part of Africa, and all of Asia, together with numerous intermediate seas and other oceans before it reached Yokohama or Melbourne. The cost per word would be as much as $2.35 to Auckland, or $2.35 to the capital of Japan.

THE MASSENA WATER POWER ELECTRICAL GENERATING PLANT.

In our issue for August, says the American Electrician, announcement was made for the commencement of work on the canal of the St. Lawrence Power Company at Massena, N. Y., and we are now enabled to

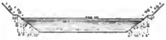


FIG. 1.—SECTION OF CANAL.

give an account of some of the more important features of this great undertaking, which involves the immediate utilization of 75,000 horse power, with a prospective utilization of 150,000 horse power.

Fig. 5 is a map showing the location of the plant and canal and Fig. 1 is a section of the latter. The St. Lawrence River has a fall of more than 50 feet over the Long Sault rapids between the mouth of the canal and the point where a small stream—the Grass River—flows into the St. Lawrence. The canal will connect the St. Lawrence with the Grass River at a point of the latter where the water will have a fall to its bed of 47 feet, of

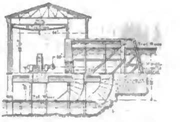


FIG. 2.—SECTION OF POWER HOUSE.

which there will be available at the turbines an effective head of over 40 feet.

The power house will be built on the bed of Grass River below the canal outlet, and will be 600 feet long by 130 feet wide. Fig. 4 shows a plan of the power house and Fig. 2 a transverse section. The turbines will be of the horizontal shaft type, two to each shaft and each pair developing 5,300 horse power. Fig. 3 shows the setting of the pairs and the draught tubes.

The turbine shafts, which are 80 feet long, will extend through a wall separating the canal or turbine chamber and the power house. Each shaft will have mounted

FIG. 3.—ARRANGEMENT OF DYNAMOS AND TURBINES.

on it a great ring of steel, which will carry on its circumference twenty external pole pieces, the ring and pole pieces being of one solid casting of steel. The former will have an extreme diameter of 15 feet and be about 3 feet wide and supported by a massive hub having ten radial arms or spokes. Each of the machines will weigh 350,000 pounds, stand 22 feet high above the top of the foundation and occupy a floor space of 22 feet by 18 feet.

The stationary part of the dynamo will form the armature and will consist of a large ring or cylinder, the inner surface of which will be made up of plates of soft, thin steel on edge held by the massive outer ring of cast iron. The inner surface of the steel plates will have slots in which will be laid copper bars parallel with the shaft of machine, insulated from each other with mica and in which will be generated the three-phased currents.

The poles of the revolving portion or field of the machine will be wound with copper ribbon. The speed will be 180 r. p. m. and the current will be generated at ...quency of 30 periods per second.

...e owners of the St. Lawrence Power Company are ...s. Stewart & Company, 40 Wall Street, New York. ...ngineer is Mr. John Bogart, formerly New York ...ngineer.

...racts for construction of the plant have been let as follows: For excavating the canal, building the power house and hydraulic work, to the Lehigh Construction Company, Limited, of South Bethlehem, Pa.; the fifteen 5,000 horse power generators will be furnished by the Westinghouse Electric and Manufacturing Company; and the turbines by the Stilwell-Bierce & Smith-Vaile Company, of Dayton, O. Seventy-five thousand horse power electrical energy are to be available before the end of next year.—American Electrician.

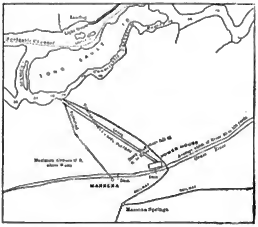


FIG. 5.—MAP SHOWING LOCATION OF CANAL AND PLANT.

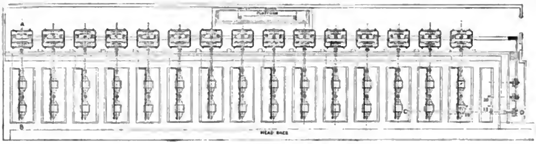


FIG. 4.—PLAN OF POWER HOUSE.

THE MAGNETIC DIP OF ANCIENT TERRA-COTTAS.

The article on this subject contributed by the Cavaliere Giacomo Boni to the Journal of the Royal Institution of British Architects, June 17, 1897, is of great importance, says the Builder. Dr. Folgheraiter's experiments have proved that clay cylinders acquire during the period of cooling after being baked a permanent magnetism, owing to induction by the earth's magnetic field. If we know the position in which a terra-cotta vase, for example, has been baked and determine the direction of the field of its remanent magnetism, then we know the "dip" of the earth's magnetic field at the period at which the vase was baked. If we know the "dip," then, as it is always slowly changing, it will be a great help in fixing the date of the vase. Conversely, if we know the date of the baking and the position in which it was baked, then we can find the "dip" at that period. Prior to 1570 we have no records of the magnetic "dip." Since that date it attained a maximum value of 74° 42′ in 1720, and then gradually diminished to its present value of 67° 30′. Dr. Folgheraiter found that four terra cotta cistae of about the eighth century B. C. show distinct traces of south polarity about their bases, which is strong evidence that at the time and place where these vases were baked a magnetic needle would have dipped toward the South Pole. The Cavaliere Giacomo Boni points out the necessity of further experiments in this direction. He suggests that brick walls which have been subjected to fire at a known date, e. g., the great council hall of the ducal palace in Venice, burnt A. D. 1575, should be examined for traces of remanent magnetism. If we can thus determine approximately the "dip" at the period of the fire, it will be an obvious example of the value of the method. A more promising suggestion is to examine magnetically volcanic rocks due to eruptions of historical date. At Herculaneum, for example, there must be plenty of strongly magnetic substances which came in contact with the lava, by examining which the magnetic dip at the date of the eruption might be ascertained.

Members of the Royal Institution of British Architects are asked to give notice of any buildings they may happen to come across which exhibit traces of magnetism induced at some former period. In a note Dr. Folgheraiter's method is described, presumably for their instruction. It is very difficult for any one but an expert on laboratory methods to understand it. It is of no great use, except as a laboratory method of determining the magnetism of something like a vase uniformly magnetized. The mysterious "arctg." mentioned is a misprint for "arctg.," or, as we write it in England, tan⁻¹. From experiments of our own on a block of asbestos, afterward found to contain traces of magnetite, we found that it was very irregularly magnetized; the lines of force seemed to radiate in all directions through the body. Baked clay, we imagine, contains considerably less than ten per cent. of the ferrous ferric oxide, which constitutes its magnetic substance; it will, therefore, be a very feebly magnetic body, and it will be very difficult to determine the direction of its remanent magnetism, especially if it is not uniform.

Electricians can determine to within one per cent. the strength of the current in an electric cable by means of a little compass, such as is often worn as a "charm" on a watch chain. Architects often use such a compass to determine the position of an iron girder or a gas pipe. A sensitive compass on this principle might be employed to detect whether there is anything abnormal in the magnetic field in the neighborhood of an old building or a monument. An expert could then find out the cause of this, and, if possible, determine the direction of the feeble remanent magnetism. It is highly probable that some curious instances of magnetic effects might be discovered by this means, if several people systematically experimented with this end in view. At any rate, speaking from experience, we can say that it is no waste of time to learn how to use a charm compass scientifically.

A NOTE ON SOME OF THE REQUIREMENTS FOR A SANITARY MILK SUPPLY.*

By WILLIAM T. SEDGWICK, Ph.D.

It is now generally recognized that the milk supply problem is one of the most pressing in American sanitation, and I am frequently asked to give an opinion as to the merits of this or that remedial measure. I have therefore thought it worth while to lay down very briefly, but I hope clearly, the fundamental principles which must be carefully kept in mind in seeking to introduce sanitary reforms into this important industry.

The fundamental, indispensable and all-controlling requirement of a sanitary milk supply is that milk, when consumed, shall be as nearly normal as possible. Normal milk is milk as it flows from the mammary gland of a normal animal, and a normal animal is obviously one that is healthy and well fed. From such an animal under normal conditions the milk supply of its young passes almost instantaneously, and without exposure to dust and air, from the milk ducts of the mother to the stomach of the suckling. Such milk is absolutely fresh, warm and free from dirt. It is not only undecomposed, but nearly or quite free from the germs (bacteria) of decomposition.

Ordinary city milk, on the contrary, is neither fresh, warm, nor free from dirt, and if not already far on the road toward decomposition, is always richly seeded with bacteria. It is not always derived from healthy or well-fed animals, and is seldom drawn under clean and sanitary conditions, so that even at the outset it may be, and often is, very far from normal. It is also too often transported over long distances, so that it still further loses its original freshness, and it is frequently manipulated by unclean, and sometimes by diseased, workmen. By the time it reaches the consumer, therefore, it is not only no longer normal milk, but usually stale, dirty, more or less decomposed, and sometimes also diseased.

Some of the steps to be taken in securing a more sanitary supply are easily deduced from the foregoing facts, and are as follows:

1. Milch cows should be healthy, well fed, well kept and well cared for.

2. Milk should be derived from such cows only, and with all possible precautions in regard to sanitation

* From the Technology Quarterly of the Massachusetts Institute of Technology.

and cleanness. Cows as sources of food should be tended as carefully as or more carefully than horses used only for burden or pleasure. The operation of milking should be looked after with special care. Above all, the hands of the milker should be carefully washed just before he begins to milk, his own personal cleanliness being even more important than that of the cow.

3. When drawn, milk should be immediately filtered and chilled, as means of retarding decomposition, and all articles with which it comes in contact, such as filters, pails, cans, etc., should be scrupulously clean.

4. The milk thus prepared should be delivered, if possible, at once.

5. If it is impossible to deliver the milk immediately, it will be impossible to deliver normal milk, and such milk cannot, in fact, generally be obtained in cities. The best that can be done, probably, is to deliver as speedily as possible two kinds of milk, viz.:

(a) The milk thus far described, kept as nearly normal as the conditions will allow.

(b) The same milk carefully pasteurized either (and preferably) on the farm where it is produced or at some central point accessible from a number of farms, or, if this be impracticable, at some good distributing point in or near the city to be served.

The former (a), which may be called "chilled milk" or "raw milk" or "ordinary milk," will be preferred by some. The latter (b), which may be called "pasteurized milk" or "sanitary milk," will be preferred by many as being certainly free from the germs of infectious disease.

There can be no doubt that any individual or company which honestly strives to displace the present highly objectionable milk supply of American cities by a supply such as has been here described deserves, and will secure, the support and the confidence of the more intelligent portion of the community.

THE PARIS INTERNATIONAL EXHIBITION OF 1900.

THE preparatory work of a great international exhibition like that which is to be held in Paris in less than three years is as interesting as its ultimate installation. Not the least considerable of these preparation works are the many buildings of all kinds in which exhibits will be placed; the extensive works which have to be carried out to facilitate the convenience and circulation of visitors; and the complicated organization necessary for the transport and handling of exhibitors' goods and cases. Progress has sufficiently far advanced to enable us to take some note of the first named preparations. The various works of demolition are being actively pursued, among them especially the central dome in the Champs de Mars, of which the steel framework is being removed girder by girder by means of a timber staging about 300 ft. in height, erected inside the building. This staging has been constructed with a clear internal space to facilitate the lowering of heavy weights, one of which is the gigantic statue of repoussé zinc which stood on the summit of the dome, and the weight of which is about 9 tons. The removal of the Palais de l'Industrie is also rapidly progressing.

The new constructive works are advancing, although at present they are chiefly limited to foundations of the new palaces; at the same time the architects of the two Fine Arts buildings are constructing plaster models of them, one hundredth full size. By means of these models it will be possible to form an exact idea of the architectural effects and decorating details, and to introduce any changes or modifications before the buildings are actually constructed. It is considered that the expense thus incurred will effect considerable economy in the end, and that the definite results must be more satisfactory. The models are well advanced toward completion, and the contract for the main façade of the principal palace has been let. It is a heavy undertaking and will cost at least a million and a half francs. One of the most interesting features at the present time is the preparatory work for the new bridge over the Seine—the Pont Alexandre III. Already the quays on each side of the river are opened up and excavations for the abutments are in progress. The inclosure of sheet piling on the right bank, within which the foundation caisson will be placed, is almost completed.

The erection of the caisson is well advanced. The method of building the foundations is by compressed air. These foundations will be actively pushed forward as soon as the air conduits are laid, and it is an interesting detail that the supply will be furnished from one of the mains of the Paris Compressed Air Company. As for the superstructure of the bridge, the designs are now completed and the whole work will be offered for contract in the course of the present month.

As we said above, the constructive works connected with the 1900 exhibition are of great interest and almost of infinite variety. Even the very temporary buildings forming the engineers' offices connected with the Alexandre Bridge possess some features of interest; they are of iron, the framework being covered by stamped plates of such a form that when put in place a continuous air space is provided between the inner and outer walls. This arrangement has already proved effective in periods of great cold or intense heat, while later on, when it is necessary to remove the buildings, the work can be completed with great expedition. Of a more important character than these temporary offices are the structures intended for the various bureaus of administration, executive, and architecture, preparations for which are now being made on the bank of the Seine, between the Champs de Mars and the Esplanade des Invalides. Some old structures without any actual use, and of which many are to be found in Paris, are to serve for these offices; they are the buildings known as the Ecuries de l'Alma, the sumptuously fitted up range of stables which at one time accommodated the horses of the Emperor Napoleon III. While part of these stables are being transformed into offices, it is also necessary to construct new buildings in the courtyards. A difficulty, however, was found in carrying out this work. The banks of the Seine are formed of stone and earth filling, resting on fine sand, easily washed out during periods of floods. Just where the new office buildings have to be erected this sand is particularly without consistence, and is absolutely unsuitable for foundations; at a relatively considerable depth, however, a solid stratum exists. In order to adapt the ground a new and very interesting system has been adopted—the invention of a well known French engineer, Mr. Louis Dulac. Some time since this engineer, wishing to erect a factory very cheaply, purchased land made up entirely to a depth of about 16 meters of rough filling of all kinds, quite unsuitable for foundations. Mr. Dulac, however, resolved to erect some very heavy structures, 3,000 square meters in area, with walls 12 meters in height and a chimney 30 meters high. He accordingly devised a very simple and inexpensive means of compressing this loose soil and making it suitable to carry the heavy weights just referred to, by means of the device illustrated. The system consists in forming holes in the ground by means of a species of pile driver, the falling weight of which is of the special form shown in the illustration; and afterward of filling these holes with hard material of small dimensions, the agglomeration of which in successive beds provides an entirely satisfactory foundation. The consolidation of bad ground en masse is certainly a novel and interesting idea, and the Dulac process appears to secure this up to a depth of at least 14 meters. To obtain the necessary consolidation of the ground a series of wells are sunk 31 in. in diameter and spaced about 6 ft. apart from center to center; these wells are then filled with lime or cement concrete, which is rammed hard by the falling weight, and form a series of monolithic columns anchored into the ground, the concrete to some extent spreading into the sides of the wells.

In order to sink the shafts, a conical pointed falling weight is employed, which, as will be seen from the illustrations, has somewhat the shape of a large carrot; it weighs 1¼ tons, and falls freely without guides from a height of 10 or 12 meters. It is worked by means of an ordinary piling engine, the frame of which, mounted on wheels, runs upon suitable rails. The falling weight is furnished with a steel point, the upper end has a suspension stem. When the hoisting chain of the piling engine is lowered, a catch with three branches surrounds the head of the weight automatically, and when the chain is raised the jaws close around the weight, holding it fast. As soon as the weight is raised to a certain height the jaws come in contact with a trip gear on the vertical frame of the piling engine, releasing the weight which, falling freely, penetrates 20 in. and sometimes more into the bottom of the well. The process is then repeated, as we have described.

Three types of falling weights are employed, each of them fitted from the same hoisting and releasing gear. The first of these types is the conical form, of which we give an engraving. With this a well 31 in. in diameter can be sunk to a depth of 12 meters in five hours, and the operation so compresses the earth around the well that the latter will hold water when poured into it.

After this the second type of weight is employed. It weighs 1 ton, and has something the form of a shell with its point downward. Naturally, this type is not adapted for boring, but is intended to ram the material that is placed in the well. This material consists of old rubbish, such as broken bricks, etc., in layers, 20 in. or 30 in. thick, alternated with similar layers of béton mixed with hydraulic lime or cement. Each layer is rammed hard by the falling weight, which drives the filling against the sides with the effect that it enters the earth surrounding, and forms a column considerably larger than the diameter of the well. It is, of course, necessary to ascertain whether the column thus formed possesses sufficient resisting power to carry its proportion of the weight of foundations, and for this purpose the third type of falling weight is used. The resistance can be easily ascertained by the amount of penetration into the mass of the column made by the weight falling through a fixed distance a certain number of times.

Where the ground has a sufficient degree of solidity, or where the weights to be supported are not great, the second type of falling weight only is used; with this wells 2 meters deep can easily be bored and the material rammed without changing the weight. In ground possessing very little cohesion the same form of weight must also be employed, as the first type is apt to go out of sight and be lost. With this system a bed of clay 40 in. thick can easily be traversed, the material being forced out both above and below. For thick beds of clay, however, it does not prove serviceable. As to the cost of the operation, it would appear that for a well varying from 1 to 5 meters in depth, the expense would be 15 francs per yard run, with a mixed filling of rubbish and lime, 20 francs for lime concrete, and 25 francs for cement concrete.

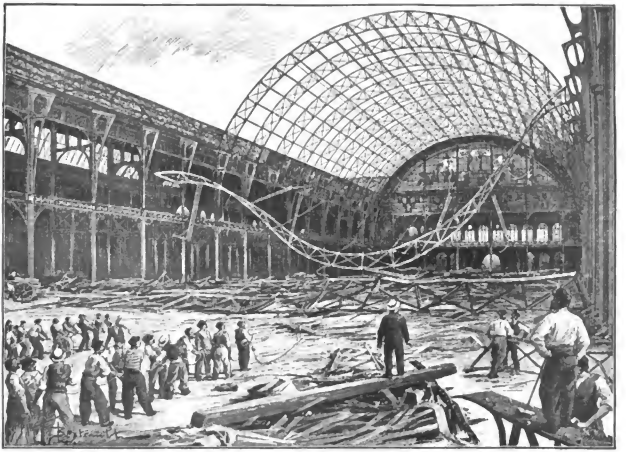
We have said that Mr. Dulac first experimented with this system on his own account, and he was able to

DULAC'S PILING ENGINE.

construct buildings exerting a load of nearly 4 tons per foot upon ground which previously would not carry one-tenth of that amount. He afterward erected a building weighing about 8 tons per square foot upon land where the first fall of the boring rake had thrown up a jet of semiliquid mud to a height of about 30 ft.

The foundations of the new administrative buildings for the exhibition are the latest executed on this plan. There is little else of interest in the structures, which are formed with steel frames, arranged to support slabs of plaster in which are embedded strips of expanded metal or its equivalent; the foundations, however, are of considerable interest, and form one of the many novelties in construction which will be conspicuous at the exhibition of 1900. It may be mentioned that the ultimate strength of the columns is about 20 tons per square foot, and that infiltration of water has been prevented by ramming the holes with broken stone set in hydraulic lime.

For the engraving and the foregoing particulars we are indebted to Engineering, and for our engraving of the demolition of the Palais de l'Industrie we are indebted to L'Illustration. This building is on the south side of the Avenue des Champs Elysées. It was built for the first Paris Exposition in 1855, and the idea was adapted from Sir Joseph Paxton's iron and glass buildings. It forms an immense rectangle, the central building having a handsome elevation surmounted by a colossal group of sculpture, by Regnault. The building, with its long wings, consists of two stories and is adorned with various medallion portraits. The central hall is 51 ft. in height and 632 ft. in length. The building has been used for various scientific and other congresses, and is notable as being the gallery where the famous annual French exhibition called the Salon has been held. The building was so well built that it was removed only with great difficulty.



THE DEMOLITION OF THE PALAIS DE L'INDUSTRIE, PARIS.

[Continued from SUPPLEMENT, No. 1133, page 18115.]

ALFRED MARSHALL MAYER.*

AMONG the acoustic discoveries of Prof. Mayer may be mentioned his observation that the sensation of a sound may be obliterated by the simultaneous action on the ear of another sound of greater volume and lower pitch, but that the converse is not true. The higher pitch, even when intense, cannot obliterate the sensation of another sound of lower pitch. This does not imply that the higher pitch is thus always completely obliterated. Its presence modifies the compound perception after the possibility of singling it out has vanished. The apprehension of this truth caused him to suggest certain changes in the method of conducting orchestral music, but they were not adopted on account of counterbalancing inconveniences in practice.

In 1876 Prof. Mayer discovered that the air pressure on the inner surface of the bottom of a resonator in action exceeds that on the corresponding outer surface. This led to the construction of the "sound mill," composed of pairs of resonators so balanced and pivoted on their supports as to be set into rotation by reaction on sounding near them a tuning fork to which they are adapted. This phenomenon of acoustic repulsion was shortly afterward discovered independently by Dvořák in Austria. Another application of resonators by Prof. Mayer was in the invention of the topophone, an instrument with which the direction of sound at sea, such as that of a fog horn, could be determined with a close approximation to accuracy. His last publication in acoustics was on the production of audible beat tones from two vibrating bodies whose frequencies are so high that the separate tones are inaudible. This paper was read at the Oxford meeting of the British Association in 1894. The existence of such beat tones has been doubted by some. In the present case I was associated with Prof. Mayer during some of his experiments, and had previously had considerable experience in the use of the sources of sound which he employed. As to the reality of the results he claimed there cannot be the least doubt on the part of any person possessing ordinarily acute powers of hearing, who will take the trouble to repeat the experiments.

The study of the physiology of sensation tempts to the investigation of the problems of vision in connection with those of audition. During the winter and spring of 1893 Prof. Mayer became much interested in the phenomena of simultaneous color contrast, of which it may yet be said that no satisfactory explanation is provided by any existing theory of color vision. It has been common to assume that the modification of color perception induced by contrast is due to unconscious motion of the observer's eyes, to error or fluctuation of judgment, or to incipient retinal fatigue. Prof. Mayer devised a variety of methods of presenting these phenomena with unexampled vividness, and on so large a scale as to enable him to arrive at quantitative statements of such subjective color by comparison with standard hues with which they were matched on the revolving color disk. Vivid contrast hues were readily perceptible when the illumination was secured by means of a momentary electric flash, and with entire accordance between different observers who had been purposely misled to expect something different from what they actually perceived. The hypothesis of retinal fatigue, or fluctuation of judgment, or ocular motion, is excluded under such conditions. This psychological element of color contrast led to the development of a disk photometer for measurement of the brightness of colored surfaces. In the use of it a degree of accuracy was attained in excess of that usually found possible with the Bunsen photometer.

While still at the Lehigh University Prof. Mayer began investigations on electricity, on magnetism and on heat, which were resumed from time to time during subsequent years in the intervals between his acoustic researches. His lecture notes on physics were published serially in the Journal of the Franklin Institute, and, subsequently, put into book form. He devised a zero method of comparing the strengths of electromagnets and electrical conductivities, made many observations on magnetic declination, and improved on previously known methods of fixing and photographing magnetic spectra. He undertook an elaborate research on the effect of magnetization in changing the dimensions of iron and steel bars—an effect discovered by Page in 1837, investigated by Joule in 1842 and then neglected for thirty years. It was about this time that an unusually large electromagnet was constructed for the Stevens Institute of Technology, and was employed with much effect in public lectures. One of these, entitled "The Earth a Great Magnet," was given by invitation of the Yale Scientific Club and, subsequently, published. In connection with it a special form of lantern galvanometer was devised for vertical projection, which attracted much notice. Another lecture demonstration which a few years afterward attracted general attention was that of the configurations formed by magnets floating vertically and subjected to the attraction of a superposed magnet.

The multiple or oscillatory character of the electric discharge from a Leyden jar was discovered by Henry in 1842. It was carefully studied afterward by Feddersen, who used a revolving mirror, and yet more fully by Rood, who employed several methods, but more particularly that of the revolving disk with radial slits. Prof. Mayer, in 1874, took advantage of centrifugal action to give steadiness to a disk of blackened paper rotated rapidly between the electrodes employed for transmission of the spark. The perforations were then subjected at leisure to micrometric measurement. Since the rotation of the disk is known, the means is thus afforded for measuring the duration of the discharge and the intervals between the successive sparks which compose it. The conditions were then studied for securing the most nearly simple discharge possible. This served as the necessary antecedent to the successful employment of the induction coil in conjunction with a method previously devised for measuring minute intervals of time with the tuning fork, or rating a tuning fork by comparison with a standard clock. The combination formed an admirable chronoscope for a variety of purposes, but more especially for measuring the velocity of projectiles.

On the general subject of heat Prof. Mayer published several articles. The first of these, in relation to waterfalls, has been already mentioned. In 1872 he devised a method of tracing the progress and determining the boundary of a wave of conducted heat by taking advantage of the variation in color with change of temperature which is characteristic of certain double iodides. The same method was applied three years afterward to the securing of thermographs of the isothermal lines of the solar disk. In 1890 he gave publication to a paper on the determination of the coefficient of cubic expansion of a solid from the observation of the temperature at which water in a vessel made of this solid has the same apparent volume as it has at 0° C., and on the coefficient of cubic expansion of a substance determined by means of a hydrometer made of it. The method was applied to several different substances, including brass and vulcanite. This led to a general investigation of the properties of vulcanite, which was published soon afterward. One of these properties is its remarkably large coefficient of expansion, exceeding that of mercury.

Soon after the publication of Roentgen's discovery of a new species of radiation Prof. Mayer's interest in this was aroused, and in June, 1896, he published the outcome of his investigation of herapathite, which had been employed by him to test the possibility of polarizing the Roentgen rays. Formulæ were deduced for the transmissive powers of several substances for these rays,

* By Prof. W. Le Conte Stevens, in Science.

including tourmaline, herapathite, glass, aluminum and platinum.

Prof. Mayer's last scientific work was an experimental investigation of the equilibrium of the forces acting in the flotation of disks and rings of metal, and an application of such rings to the determination of the measure of surface tension of liquids. The method was wholly new, and the agreement among results was remarkable. At best, it has been difficult in the past to secure reliable results in work of this kind, and the present work is fully equal, if not superior, to the best hitherto accomplished by Plateau and Quincke. It was done during the intervals between periods of acute physical suffering, and its appearance in the American Journal of Science for April of the present year preceded by only a few days the paralytic stroke which demonstrated that the investigator's life work was already ended.

In this brief sketch of Prof. Mayer's labors but little has been said of his numerous happy devices for lecture demonstration. His restless ingenuity was ever ready for any demand, and his mechanical aptitude was so directed by a delicate æsthetic sense that he could never be satisfied with any objective proof which was not neat and simple, as well as adequate. A few of these he published from time to time. Among them may be mentioned methods of measuring the angle of inclination of the mirrors employed in Fresnel's interference experiments; of obtaining a permanent trace of the oscillation plane of the Foucault pendulum; of registering and exhibiting the vibration of rods; of deducing the fundamental laws of electric repulsion by means of the pendulum; of measuring potentials and specific inductive capacities with the spring balance electrometer; of proving Ohm's law, and of expressing electric potential as work. Many of his demonstrations in acoustics were gathered into a small volume on "Sound," and have thence been copied into the elementary text books of to-day. The same may be said of a little volume on "Light" prepared with the co-operation of Mr. Charles Barnard. In the student laboratory he was as efficient as in the lecture room, fertile in devices and ever insistent upon a high standard of accuracy. No one knew better than he that demonstration and practice work are of insignificant value in comparison with investigation; but he kept always in mind the fact that, in America at least, the physical investigator is nearly always compelled to be in some way a teacher, and that in teaching physical science demonstration and theoretic instruction must go hand in hand. He was conscious of his skill and, naturally, took keen pleasure in exercising it successfully. That in so doing he gave pleasure and help to others is manifested by the extent to which his methods have served as models.

The manipulative skill and tactile delicacy which are so necessary as adjuncts to independence and ingenuity in the laboratory were applied with no less success by Prof. Mayer in outdoor recreation. Early in life he became an accomplished marksman; and during manhood, as long as good health lasted, he was an ardent and exceptionally successful sportsman. His field and laboratory interests were combined in his application of the tuning fork to the problems of gunnery. In the Century Magazine he published a number of articles on sporting subjects. These were incorporated, along with contributions from other sources, in a volume entitled "Sport with Rod and Gun in American Woods and Waters." This volume was edited by Prof. Mayer, and for it he specially prepared two valuable articles, one on "The Shot Gun" and another on "The Blow Gun."

In addition to these literary labors, Prof. Mayer contributed many articles to the cyclopedias of Appleton and Johnson, besides occasional popular articles on scientific subjects for other media of publication. In acknowledgment of his earlier contributions to science the degree of doctor of philosophy was accorded him in 1866 by Pennsylvania College. He was admitted to membership in the National Academy of Sciences in 1872, and was a member of each of the leading scientific societies of America, besides being a corresponding member of the British Association. He served during one year, 1873, as an associate editor of the American Journal of Science, and during the first eight months of that year five articles from his pen appeared in its pages. The partial failure of his eyesight then necessitated cessation from all work, and a considerable part of the next scholastic year was spent in England, where his reputation had preceded him and where hospitable entertainment was accorded by the most prominent representatives of science.

In the closer circle of personal friendship it is hard to speak with impartiality while the sense of bereavement is still fresh. A man's personality penetrates into all that he does, into his writings quite as unmistakably, if less positively, than into his conversation and the atmosphere of his home. In a eulogy on Joseph Henry, to which I listened at Cambridge just seventeen years ago, Prof. Mayer said: "His best eulogy is an account of his discoveries; for a man of science, as such, lives in what he has done, and not in what he has said, nor will he be remembered for what he has proposed to do." In comparing Henry with Faraday he remarked: "Each loved science more than money, and his Creator more than either." Mayer proved himself a worthy pupil of Henry, and their friendship grew in strength until broken by the last great Destroyer. His words may now be properly applied to himself. The characteristics of the gentleman, the high toned man of honor, were born in him. They needed no cultivation beyond the natural development and confirmation which accompany the attainment of maturity. Those who were favored with his friendship need no reminder of his generosity, his ready sympathy, his quick insight and hearty appreciation, his enthusiasm verging sometimes almost upon that of boyhood.

The value of Mayer's work will be tested by time. For some parts of it he will unquestionably be long referred to as an authority by stranger as well as friend. He dwelt in an atmosphere essentially unfavorable to the spirit which directed his work, for nowhere in the world can there be found so high a degree of general civilization conjoined with so small a degree of general appreciation of pure science as in America. This may be said with full recognition of the abundant rewards here accorded to science successfully applied in industrial fields, and of the rich endowments given by wealthy individuals to some of our educational institutions. But the man who advances theoretical science in America receives not a tithe of the recognition given to the inventor who puts on the market a merchantable device which pleases the multitude. Prof. Mayer would have done his scientific work to better advantage in France and Germany. But be this as it may, we who knew him in his work must now know him only in memory. To have had him as a co-worker and friend is now a sad pleasure, and one that nothing can take away.

[Continued from Supplement, No. 1133, page 18109.]

IMPROVIDENT CIVILIZATION.*

A PLEA FOR THE APPLICATION OF SCIENTIFIC METHODS TO THE AMELIORATION OF SOCIO-ECONOMIC DEFECTS AND DISORDERS.

By Richard T. Colburn.

II. DECADENCE OF RACES.

The abstraction of numbers by warfare and the privations of army life, vast as they were, do not account for the decline and degradation of the great empires of the past. Besides, decay seems to overtake the conquering as well as the conquered race; and there are instances where the enslaved have become in turn enslavers. Mere numbers are not strength nor tenacity of nations: witness the Hindoos. The old Greeks were not numerous, but what they lacked in numbers they made up in vigor and sagacity.

What are these other causes of premature decay? In other words, is there a natural term of life for races, as for individuals—a cycle of growth, maturity and senility? Dr. Charles Pearson, in his work on the "Life and Character of Nations," has attempted to answer these questions and, in addition to other minor causes, traces the decline to an inherent difference of stamina or staying power in the ethnic divisions of mankind, corresponding to our present external classification of races by color of skin and hair. The startling conclusion he reaches is that the swarthy or dark-skinned races are destined to outlast, and of course supplant, the lighter-skinned or Aryan group. The evidence is scanty and inconclusive; but it is significant and carries us back directly to the interesting controversy now waging between Prof. Weismann and his critics as to the quality of the germ plasma and its transmission without impairment or improvement, into which we cannot here enter. The rival hypotheses of Galton and Cope deal, however, with problems belonging to the sociologist as well as the zoologist and microscopist.

The doom of the light-skinned races, according to Pearson, is fixed, for it is not to be averted even by admixture. The bearing of purity of race on its persistency is far from being worked out. So far it goes to show the active dominant types are mixed; while the purer races are few, isolated and nearly stationary in civilization. Whether these differences be due to reversion of ancestral types—atavism—or to the greater complexity of organization and nerve strain, is an interesting study which we must ask the biologist and somatologist to elucidate for us.

Just why the builders of Assyrian, Phenician, Nile Valley, Yucatan, Grecian temples, thousands of years ago, have not left their qualities to their descendants, may be due to other causes than the stability of the somatic cell or to intermarriage; for instance, denudation of forests, inroads of infectious or contagious disease, insect pests, errors in diet, the warrior occupation, or a combination of all in greater or lesser degree. The higher types of men seem to have arisen along the broken coast line, or in the moderately elevated regions. The great plains or steppes have not been favorable to density or quality of population or to courage or vitality. The liability to periodical prairie grass or forest fires may have stunted the development of men and animals alike. Meteorological conditions are important to flora and fauna; the annual mean of sunshine, the precipitation of moisture, the range of extreme temperature, and the degree of humidity are factors of survival in the geography of races. The more northerly seem to prevail over those nearer the equator—provided we do not go too far north—due allowance being made for the modifying influence of ocean currents and altitude above sea level, the lines being not exactly isothermal but hygrometric. Singularly enough, there are notable exceptions to this rule. In the dry deserts of Arabia are to be found, among a population of Bedouins, chiefs of noble mien and splendid form, descended apparently without dilution from a remote ancestry. So in Abyssinia, almost a hermit nation, as Slatin Bey tells us, the natives combine great physical endurance and courage, under the most adverse surroundings of plant life and notwithstanding the general prevalence of syphilis, long supposed to be an escutcheon of civilized mixed races, and a very sword of destruction. The example of the Jews so frequently cited in favor of purity of race is important evidence, but complicated with other than ethnic factors, such as the Levitical code of hygiene, the rite of circumcision, the confraternity caused by ostracism, restricted occupations and social temptations, each of which plays a part in the endurance of races.

As a matter of fact, the population of those nations which make enumerations has largely increased since 1815; but this has been made possible by the opening of new sources of food supplies, for which exchanges of manufactures have been given. In spite of the migration of more than twenty millions to distant parts of the world (America chiefly), every considerable area has increased its own numbers; and it is only quite recently that France, the sole territory where emigration is practically nil, or less than the immigration, is found to be stationary or slightly declining. There is a well founded suspicion that what is now happening to France will, in due time, happen to the others from the same causes. Is the fate of Rome, Carthage, Venice, Thebes, to be repeated? Macaulay's New Zealander sketching the ruins of London Bridge is prophecy alluring to the historian, but it also finds ready acceptance among social philosophy essayists, who offer, however, the most divergent array† of moving causes, such as the decline of marriage, vaccination, flesh eating, narcotics, condiments, degeneracy, iced drinks, sewerage, irreligion, destruction of caste distinctions, etc.

Unless we assume that there is in each new birth a redemptive power, a dropping of the taints of parentage, the human race ought logically to have come to an end long ago. In some way, as yet obscure to us, in which natural selection plays its part, health must be catching as well as disease; otherwise the major and minor pestilences would have brought a quietus. Phthisis is a comparatively modern disorder. Cancer is another of the internal lesions coming to be known as induced diseases of the blood which may be carried about to all climes and propagated with fatal facility. Whether the special bacillus starts the decay of the lung tissues or follows as a sequence of the decay seems to be still in doubt. Pathologists are just now enamored of the theory of antitoxine inoculation—a sort of tame medical ferret sent in to combat the invading rodent organism. If this is our best hope, the ravages of tuberculous, cancerous and febrile ailments leave civilized races but a short respite.

The researches of Sternberg and Metchnikoff into the function of the leucocytes as guardians of the normal state of arterial currents is more intelligible and logical—if the hypothesis of phagocytosis shall be established—as this leaves the work of eradication of the blood deterioration in the hands of the organism itself, not wholly beyond human control, makes it largely an affair of metabolism of food into living cells with a counterpart activity of the emunctories. The function of the ductless glands in the formation of these blood cells is the corner of histology and pathology now awaiting special researches, and from which we may expect refreshing relief from the antiquated fetish theory of antagonizing drugs.

History concurs with physiology and with statistics in the view that civilization is not favorable to marriage and fecundity, though it may be more propitious for the rearing of offspring. In spite of the surcharge of sex passion which nature has thrust upon men, and the equally enticing wiles and coquetry of women, most of whom must look to marriage as a career, it is more and more of a failure. Polyandry and polygamy are being crowded out by monogamy, but the philosopher is tempted to ask whether monogamic union and the family as we know them are also to disappear; and, if so, what will take their place? Shall it be a return to celibate asceticism or a resort to the state as foster mother?

For some occult reason it is not as easy to be born into the world, now and here, under civilized conditions, as formerly under semi-civilized. The proportion of stillborn may be less in our days than formerly; it probably is, but the infant mortality is greater. The mortality of parturition increases alarmingly, notwithstanding aseptic devices. One may well ask why the parturition of the homo sapiens is attended with so much hazard. Whether the civilized man habitually mates at a later period in life than the savage, after the pelvic bones and ligaments have lost much of their elasticity, or that a larger cerebral development of the modern infant, out of proportion to the bony or muscular framework, renders him less viable; or whether the replacement of the earlier sage femme by an accoucheur with his case of instruments and anesthetics is more responsible for the increased mortality we leave to gynecologists to decide. The change of both sexes to indoor employment in shops and factories rather than arduous labors out doors accounts for some of the loss. The net result in grandchildren may be the same as for prehistoric man by reason of better care during the period of adolescence.

If our census statistics are trustworthy, prudential as well as physiological causes are at work in the same direction. Families do not arrive so early, nor in such quantity, as in primitive life. The perpetuity of the race is left to the unthinking classes. The aversion to child-bearing crops out (especially in large cities) in various ways. The practice of abortion, very common in Asiatic countries, and suspected to be very prevalent in Europe and America, proceeds, of course, from prudential or economic considerations, fashion, or avoidance of social penalties. We know that the advent of girl children to the Chinese and some other peoples is looked upon as misfortune; as might be expected, feticide and infanticide are common. Fear of want, love of pleasures and varieties, dread of pain and risk of death, the handicap in matter of house renting, awe of the religious authority—all play their part in this great matter of diminishing population, which has engaged the attention of the French savans and legislators, and the sacerdotal government of Quebec.*

The optimist queries: "Why worry about the extinction of the human race?" which reminds one of the American Plato's reply when told by an Adventist that the end of the world was at hand, viz., that "he could get along very well without it." The question whether perpetuity of race is desirable is equivalent to asking whether anything human is worth preserving. It is answered by science and ethics alike: whatever may be the rights of the individual over his own life, the plain inference from study of nature is that parents exist more for the sake of children than children for parents; life is essentially a sacrifice of the passing for the coming link. The more serious query for us is to know how it may be lengthened, or extinction avoided. Not one of us cares to be of a declining or prematurely dying race.†

* An address before the Section of Social and Economic Science of the American Association for the Advancement of Science, August, 1897. Mr. Colburn is vice-president and chairman of this section.

† Mr. H. A. Reed, for instance, finds in the proneness to alcohol and narcotics an artificial or[illegible] exterminating those least able to carry their load of poison.

It was reserved for Mr. Brooks Adams to discover that the scarcity of the circulating medium (in this case the depreciation of white metal is in mind) was decimating the white race.

* The birth rate of the New England States ranges it seems between 18 and 22½ per mille, while that of the far West States is still less, or less than that of France, and, being lower than the death rate, means, unless redressed, ultimate extinction.

† On this very point an interesting and instructive bit of testimony has recently come to hand.

The opportunity of studying the aboriginal life of those interesting islanders in the Pacific Ocean is passing before our anthropologists, and physiologists have extracted the whole lesson for the benefit of learning. The British government recently appointed a commission to examine into the decline of the population of the Feejee Islands. The proceedings, in [illegible] amusing, might have been more instructive had it been composed in part of trained feminine obstetricians. The inquiry disclosed a birth rate surprisingly high, much higher than the average of Europe, and a death rate still higher, and all sorts of reasons were offered to account for it, as it was a concomitant of the coming of the Caucasian race, the onus fell on traders and missionaries. The testimony of an elderly accoucheur, familiar with both conditions, revealed the fact that the native women had become indifferent to the obliteration of their own people, and this because the [illegible] and [illegible] had been taken out of their lives; a sense of sin had been introduced, and these Gardens of the Hesperides had

Gratification of the gustatory nerves, located at the back of the tongue (which is not at all identical with the appeasing of hunger), together with the convivial propensity of man, a corollary of his gregariousness, is responsible for a part of his shortened longevity. It has its double aspect of physiological and psychical influence. No people suspect their daily food, or beverage, to be harmful; for the most part they would as soon tolerate criticism of their religion, their patriotism, their wives, as their bill of fare, but each in turn freely expresses his contempt for the table of the others. Is there not some underlying vice in the habitual food of the civilized world, which, of course, includes its preparation? Of the grass seeds which furnish the staple for the bulk of the world, rice constitutes at least half. Christendom prefers the wheat, rye or maize, which we esteem as the superior grain; yet the Chinese and Japanese contrive somehow to nourish stout sinews, though more diminutive bones, and acute brains and courageous hearts out of the blander grain without recourse to much animal food. Their superior recuperative power in hospital against injuries and lesions of disease is notable. The conquering quality of British tribes is believed to be due to the ample ration of beef, of the German to his of beer and sausage; of the Mediterranean littoral, to their free use of wine. To modern science we are indebted for the explanation that the decoction of the coffee berry by the Levantines and of the tea leaf by the Mongols for ages has probably contributed to their survival, by supplying a boiled or fermented liquid, which was doubtless comparatively more free from morbific bacterial organisms than the polluted wells from which the water was drawn, in those densely crowded and ancient abodes. The medical view that life is shortened more by overeating than by starvation, in its ordinary sense, is confirmed by the chemist's laboratory tests, and by the spectacle of contrasted races. Can we not, while imparting our science, philosophy and literature to the Chinese and Japanese, take a lesson or two from them on diet, and perhaps on clothing and house furnishing also? Their comparative exemption from phthisis, cancer, insanity and neurasthenia (aptly described respectively as atrophy, mutiny, and exhaustion of the cells) alone should put us upon our inquiry.

A leading American physician has said, more or less jocosely, that compared with the present, the coming man will be a big headed, small bodied, puny limbed, bald, toothless, spectacled and toeless creature subsisting on concentrated foods, to which we may add the qualifying remark that he will not keep coming for any long period. The fate of that people where teeth and eyes decay and dentistry and opticians flourish is not at all conjectural. It concerns the student of physiology and sociology alike to ascertain what causes are at work impairing the digestive organs, the teeth and eyes of civilized peoples, and in what respects the as yet uncivilized have a manifest advantage.

Making due allowance for the power of accommodation of the system whereby blood and tissues are made out of so wide a range of food stuffs, the conviction forces itself upon us, seeing the effect of alimentation upon plants and animals, that while the norm may be a shifting one from youth to age, there is a norm, and that deviations from it must tell upon the vigor and endurance of the race. The very general use of salted and smoked meats for example; has not that had much to do with the increase of gouty and rheumatic affections, usually attributed to acid fruits or wines? This practice could easily be dispensed with, by the use of cold storage and desiccation.

Then again, the civilized man, and especially the woman half of him, habitually lives in a warmer, closer atmosphere than the savage. Have not our airtight houses, with their stoves, steam pipes, furnaces and weather strips, contributed not a little to diseases of the respiratory organs? Nay, the presence of a cellar under the dwelling rooms is a suspicious coadjutor. Then there are the germ dust gathering carpets, curtains, portieres, plush furniture—are they not in some degree responsible for the spread of pathogenic bacteria upon tissues already weakened by defective nutrition?

An English physician, lecturing to a recent graduating class, as reported in the Lancet, ironically said, by way of caution against excess of confidence, that "the average life of a fact in physiology is about four years." Intended as a reproach upon the practicing medico for his running after new therapeutic discoveries, it is also an encouragement and a compliment that one error can be run down, and superseded it may be, by another, in so short a space as four years. Alas! it takes a much longer period, on the average, to exterminate some of the so-called facts of social and political science.

III. PERNICIOUS COMPETITION.

Prof. Cairnes happily hit off one of the most salient features of the literature of political economy, of the passing generation at least, when he styled it "a more or less handsome apology for the present state of things." One cannot but feel that it has been for the most part a thrashing over of old straw, and even now with enormous output of printed matter, there is very little beyond a rehash of the old controversies about wages, funds, rent, balance of trade, incidence of taxation and so on. Writers divide themselves into three classes, each of them defective without the other two; the historians and academicians who have gone over the writings of their predecessors and who know but little of the business of the world; the statisticians who put faith in their ability to reckon up into tabular form that which is incomputable, as well as that which is, and whose industry is out of all proportion to its value for scientific use; then there are the enthusiasts who [illegible] profoundly dissatisfied with the present distribution [illegible] wealth or the conditions of industry, and who [illegible] schemes of reform and then turn the [illegible] figures round as upon a swivel in support of the ideas. Doctrinaires, who for the most part write the treatises and books about finance and trade, know but little of the world about them; while the bankers, arbitrageurs and movers of the world's crops and tonnage are too busy to write about what they understand. The result is the literature of political economy is about one generation behind the practice. Especially is this true of international finance.

The new world, having a virgin territory to occupy and improve, has run in debt to the old somewhat recklessly. The burden of interest and repayment of the capital is irksome. Extension of the debt at low rates is dependent on capacity to pay if demanded. So long as we are handicapped with this mountain of debt, it is in the power of a few foreign holders of our promises or titles to property to bring on a panicky feeling at any time they choose, though fortunately it is not for their interest to do so, but the time may come when it will be. Besides this hampering of debt, there has been an unconscious extravagance, of which we shall have more to say when we speak of the tendency of luxury. In a wholesale way we have been exchanging our liens on and evidences of ownership of lands, timber, railroads, manufactories, mines, breweries and the like for shiploads of merchandise, the bulk of which we should have been the better for not having at all, and nearly all of which we might have made for ourselves. To get square will cost us hard work and self-denial. With the exception of this broad distinction of debtor and creditor nations, and of the latter supplying articles in which there is limited competition, all the world is engaged in a general scramble in which cheapness of production is the goal. The industry of nations has developed into a species of hostile contest, not quite so hazardous as actual warfare, but demoralizing and exhausting in a less degree only. It is as if all marches were required to be forced marches; and all business must be conducted on the brink of the precipice of bankruptcy. It was always so within the confines of a given territory; but the substitution of steam for animal power and of dexterous machinery for handicraft has not only intensified the competition within the old boundaries, but has also set the maritime nations to trying to undersell each other. In this contest for cheapness, standards of living, hours of labor, habits of frugality, depth of purse, vigor of body and acuteness of mind all have their part to play, and the efficiency and economy of government, stability of institutions, probity of character are also pitted against each other. Individually and collectively, an ordeal, growing more and more severe, confronts all trade, agriculture and manufactures. When the five hundred millions of Eastern Asia shall have grasped our mechanical inventions, it is idle to suppose the occidental standard of living can be maintained if the régime of unrestrained competition is to continue.

This is the crux of the labor problem, and also in large part of the commercial and financial problem. To the older writers aiming their arguments against the arbitrary and often absurd restraints of trade by statute, it seemed as if perfect freedom of trade was an ideal state of things, to usher in a millennium. The question has become too broad for local statutes. Freedom of trade breeds extravagance, improvidence, overproduction, followed by panic, depression, enforced idleness, discontent, and so on in recurring cycles. The struggle is too keen; it is the cosmic struggle for existence intensified, socially wasteful and destructive. Too many men are in trade; too many trying to "live on their wits," with the result that the peasantry of all nations are being worked too hard and robbed of their share of the gross product.

Less than half the population of Christendom is at work, half of those in agriculture, fifteen per cent. in professions and public service, while ten per cent. are in trade and transportation. Left to itself, we may be sure that by natural selection the weaker in trade will be forced to the wall and the few fittest will survive, but the competition will not stop; that must go on unless some general corrective is discovered. The tendency in domestic trade may be found in the mammoth department stores, which are surely crowding out their smaller competitors, and this results in such dislocation of trade from its usual channels as to engage the attention of legislatures and turn elections. It is obviously the fact that in nearly every city or town there are about five times as many merchants in a given line of business as are necessary, each with its corps of clerks, bookkeepers, delivery wagons, etc. If the saving of a concentration is shared with the customers, as it certainly is in practice, the community of buyers will have no reason to complain, but it is otherwise with the producers and manufacturers, who must submit to the prices dictated by the big concerns, who are frequently able to take the whole product or refuse any. The power of concentrated capital and marshaling of labor, which has been going on in mechanical occupations, has now spread into trade, shipping, finance and even into educational pursuits.

The smaller rivals are seeking shelter with the larger ones by absorption or alliance to escape a worse fate, as we noted in the case of political aggregations. This has led to consolidations and leagues under the name of trusts or other fiduciary contrivances. Railroads cannot escape from being dragged into this pernicious rivalry; they are under control of their patrons rather than of their stockholders. The legislatures, sustained by the highest courts, say they shall not combine "in restraint of trade;" though they are reluctant to cut each other's throats in competition, they are compelled to keep in the game at the same rapid pace as their customers. Regimentation and coercion in labor, hardly less intolerable than regimentation and obedience in militarism, are threatened unless some remedy can be devised. Laissez faire points toward a cruel and despotic struggle which is discouraging in the extreme; nor is there in the province of legislation apparently any adequate relief.

The step from a status of slavery to that of serfdom with a claim on the land for subsistence was important; the evolution from that to voluntary contract was equally so, and no people holding to either of the former systems of labor can hope to contend against the latter. But the régime of free contract is hardly a finality. The rankest injustice is perpetrated under its forms all over the world where proprietary rights are acknowledged. It is, of course, far better to require the consent of laborer and employer, but with this consent great wrongs are possible—are, indeed, common. This is a very grave question in social science, "how to put a curb on astuteness," as a magazine writer has styled it; how to shield the weaklings and credulous from spoliation by the crafty and unscrupulous. How shall the ignorant and confiding part of the population be safeguarded against overreaching, temptations, wiles and wares set for them and for each other without opening the door to still greater evils? These lures are of all sorts and degrees, from the knave who offers to sell counterfeit money or lotion to beautify the complexion to the banks, insurance and trust companies of many kinds; nor are the learned professions above setting traps for the unwary or of suborning the press into becoming accessories. Look at the enormous outlays for advertising proprietary medicines, which debauch and befog the public conscience, if they do not injure the public health.*

It is not easy to suggest a rectification of the evils of unbridled competition, especially where statutory restraint is either aggravative or impotent. With some hesitation I venture to point out some of the underlying causes of our trouble.

First, let me ask, "Why do men engage in and remain in trade, or enter upon any of the professions?" The usual answer is, "To earn a livelihood;" but this is not all. In civilization certainly there is the further motive of a desire to succeed, to become a master in the craft if possible, and whether or no, to amass some surplus of possessions as a provision for old age, to win society prizes, to dower daughters, start sons in business, perhaps found a house, endow a charity, build a monument, or leave a fortune, all of which motives are of the mind. We each of us see, or think we see, the wisdom or necessity for any one or more of these aims and purposes in life. Men and women are the slaves of ideas, and words stamp ideas so firmly on the average mind that they are with difficulty dislodged. What different ideas are conveyed by the words "success in life"! Not one in a thousand analyzes the thought to see its relativity or instability. If there were no need for a provision for old age, or for charity bequests, the extra industry would be needless too. If there were not the ambition to win, to excel, to outrun or outgather, the tremendous exertion of the rivalry would be stupid. Partial attempts are made to do away with the necessity for individual provision for the infirmities of old age by providing retiring pensions for the army, and in some countries for civil officers also. For those not directly in the service of the state, poorhouses (which are too often poor homes) are established by law; and some states now propose to aid by labor pensions also. These arrangements are the just and necessary sequel of a state of things where human life and vigor are sacrificed wholesale in the strife for cheap production.†

Second.—The eradication of the vanity of emulation, the desire for distinction, may be more difficult, but something might be effected in that direction. Suppose, for the occasion, that there were no prizes to run for, there would be less racing; I mean not material trophies, but the distinctions and adulations of winning in any contest, athletic, professional or social. If, by some happy contrivance, as much pains were taken to encourage confraternity and equality of estimation as is now taken to encourage leadership, and dissimilarity of estimation, would not much of the social strife and worry disappear? Within the family such inequalities are generally frowned upon. Can we not extend the ethics of the family beyond its pale to the whole social organism? The idolizing tendency of human nature is one not to be proud of or stimulated, but rather to be repressed. Why would it not be well to commence with infancy, in school or business, and abolish all prizes, honors and bribes of every sort for simple good conduct, or for doing one's best? Where there are winners there must also be losers; and for the latter there is very little regard outside the family, which discouragement is of itself conducive to further failure, bitterness, malice or suicide. The office should seek the man rather than go to the persistent intriguer or shameless "hustler." Aside from the fostering of an unwholesome sense of superiority, does not the whole practice of merit marks and competitive examinations of our schools and colleges work badly, in favor of a certain superficial readiness of mind which will have advantage enough over a less precocious maturity without conventional badges? The honors and emoluments of public and private station go together, a duplication of pay. It is one of the most somber traits of the older civilizations surviving in great vigor, the

[illegible] ... and disciplinary plantations, workshops and ... of a ... [illegible] ... the Hawaiian group; the ... is fatal not only to the life of the inferior race, ... the worry of competition, and modern ...

[illegible] ... with our competitive civilization and ... itself, and in Buddhist lands? Have they ... that would be full enough of ... [illegible] ... of the Japanese babies as compared with ... [illegible]

* H. J. Davenport, in his recently published "Outlines of Economic Theory," tersely sums up the evils of competition in trade:

"The stimulus of private interest works out in a vast amount of crime and disorder which necessitates, in policemen, courts, juries, sheriffs and lawyers, the expenditure of social energies. Likewise in purely private affairs the expense of preventive methods against ill faith and dishonesty is a weighty matter. Outlays of this sort would be relatively small in the collectivist system. There are large wastes of energy in competitive attempts to give to cheapness the outside gloss of value. Shoddy in cloth, paper insoles in shoes, clay in soap, sand in sugar, not only waste the energy of putting them in, but largely destroy the usefulness of the honest product. Socially speaking, all this cheapness is excessively dear.

"There is a similar compound of waste in the enormous outlay for newspaper puffing and lying. The entire system, also, of marketing through agents and commercial travelers has in it large elements of waste. The excessive multiplication of middlemen generally falls under the same head.

"The present system is also responsible for hordes of human beings living by their wits or their worthlessness: social make-weights, paupers, vagabonds, speculators of useless types, prostitutes. Parallel with these are the respectable do-nothings, the leisure rich, the inheritors of wealth, the coupon cutters. Within this class of respectable make-nothings must be reckoned also the table and waiting maids, the outriders, footmen, servants and flunkies whose energies never work out in any utility, for which the world has any real need. And in a background of misery stand the unemployed, with whom, as misery, we are not at present concerned, but only as waste. Never an inconsiderable class, they swell in times of depression to an enormous army."

"Fashion demoralizes industry and fosters starvation. Warehouses are filled with commodities to supply a demand that has vanished or to forestall a demand which never appears. Beggary and ruin result. A novelty strikes the popular fancy; there follow extensive profits, intense production, multiplied factories, prosperous allied industries, growing cities, in flocking laborers, investment, speculation. Fashion grows cold when the commodity becomes cheap and [illegible]; then failures, closed factories, [illegible] capital, collapsed boom, [illegible], hunger and riot. Almost all industrial centers know something of this experience. All over the world there are Nottinghams regretting a banished lace industry. The law of industrial peace is ebb and flow, change and uncertainty. Fashion in commodities is parent to business gambling, great fortunes, great losses, feverish activity, feverish lassitude, fluctuation and bankruptcy." (Pp. [illegible] et seq.)

† Mr. Plimsoll convinced his government that near 2,000 sailors' lives were recklessly lost yearly through overloading. We may note in passing that the need of such provision is seldom found among proprietors of the soil, small or large; the farm is the savings bank and, in the hands of a practical farmer, a very good one. Seldom is the working farmer often spurred by the ambition of vanity "to cut a figure" or win some distinction in the [illegible] ranks. If himself or family lacks a pension at the outset, it is [illegible] a sort of contribution to the common enjoyment, and not as a distinction of social caste, nor does he require the relief of pauper acts in old age.

readiness to fall into line obediently behind the nominal leader. When physical prowess was the surest road to distinction, the sway of one man power was a necessity. In these days of deliberative assemblies of quasi-equals it is a vestige of former subservience. Perfect equality of mind, or stature, we shall not have; but there is no justification for putting the tall man on stilts and lopping off the shorter ones. This is just what our present civilization is blamable for doing. The winner, if only by a nose length, or by a scratch, is elevated out of all proportion to his excellence. If we must "play pretend" at all, why not minimize the differences between coadjutors, rather than exaggerate them? Some may declare that, all men not being alike, they cannot be treated alike. Certainly not, but we ought not to magnify or multiply the rewards for the superiority which, if it does exist, nature is sufficiently discriminative without the help of social man.

Third.—Corollary to the provision for maintenance in old age or disability is the necessity for some system of more constant and steady employment prior to decrepitude. At the best of times fully ten per cent. of able-bodied laborers, mechanical or factory hands, are living in enforced idleness, and in times of depression the percentage is very much higher. The difficulty here, too, is in part psychical. It is not enough that the laborer wanting work and the employer wanting work done succeed in finding each other; the latter must be satisfied not only as to the wage he can pay out, but also as to the character of the proposing laborer; he does not want to introduce discontent or disorder among his men. This trust or confidence is almost impossible in an idle population drifting across a continent. Without going so far as to affirm the right of the willing laborer, even if he have a family depending on his exertions, to employment by the state; still the community has him and his family to support in some way; why not do so in a systematic and economical way? It may be said that it would discourage saving habits, but the present plan does worse; it begets a lack of sympathy. If every county in each State (it would operate badly to have it in some and not in others adjacent) were to lay out in advance some useful public work, sufficient to employ the quota of discharged laborers, at a bare living wage, to prevent tumult and pillage, credit being resorted to if necessary, the positive benefits might not be so great, but the unseen damage might be averted. Central Park, in New York City, owes its existence to an impromptu politic stratagem of this sort; and there is not a city or county that might not resort to similar works of transport, embellishment or sanitary aids, greatly to its advantage, and thus mitigate the severity of panic waves.

(To be continued.)

DENDROBIUM VICTORIA REGINA, LOHER.

OUR illustration gives a representation of this pretty species. The plants were sent to Messrs. Protheroe & Morris, who offered them on Friday, June 18; and, therefore, the proof of the correctness of the description, which purchasers look so anxiously for in the matter of a "blue orchid," was not long delayed, for specimens of it have flowered in several collections and have generally been considered satisfactory. The specimens vary somewhat, but all bear white flowers colored on the outer halves of the segments with shades of blue. It is stated to be a native of the Philippines, growing at an altitude of 6,000 feet. The plant from which our illustration was taken was exhibited by Thomas Statter, Esq., Stand Hall, Whitefield, Manchester (gr., Mr. R. Johnson), at the meeting of the Royal Horticultural Society on August 10, when it was given an award of merit.—The Gardeners' Chronicle.

AGRICULTURAL.

ALL the counties of the State of Ohio are now organized with from one to six farmers' institutes in each county, and from reports of the meetings of these institutes, from November 30, 1896, to February 27, 1897, as made to the Ohio State Board of Agriculture, the board publishes an interesting volume of lectures and papers thought to be of value to farmers, stock breeders and horticulturists, from which we make a few extracts. It may be interesting to note that the attendance at these institute meetings varied from about 200 to 800, presumably mostly farmers, at each meeting, the total attendance at the series being given as 85,469.

CONDITIONS OF PLANT GROWTH.

By S. H. HURST, Chillicothe, O.

Next to fertility and water in the soil, mellowness or refinement is a factor in the growth of crops, and this condition of the soil is almost wholly under the control of the farmer. Barnyard manure or decomposed vegetable matter of any kind is promotive of mellowness, and a degree of moisture is necessary for the most inviting plant bed. But refinement by cultivation is generally an absolute necessity. Years ago it was common to see corn planted or wheat sown in cloddy ground where a half crop seemed an impossibility. But improved methods have brought the clod crusher, the smoothing harrow, the disk harrow and drag into general use, and now no intelligent farmer thinks of planting or drilling for any crop until his soil is in good condition. A good seed bed is the first consideration. We refine and mellow the ground before planting, to prepare a mellow seed bed, and we cultivate and refine the soil as the plant develops to maintain a mellow root bed. In the work of cultivation it is no error to say or to suppose that we cultivate the crops. We do not, primarily. We cultivate the soil to make it mellow and fine, so that it will hold the fertilized moisture, and thus invite and promote root growth and root feeding. We certainly do not want to cultivate a plant simply to lacerate or destroy or shorten its roots, thus depriving it of the power to feed on the vegetable nutrition or fertility around it, and with our modern ideas of level culture we do not plow to "hill up" the plants. The two legitimate offices of cultivation in crop growing are the refinement and mellowing of the soil and the destruction of the weeds. After corn or potatoes are planted, it can scarcely be desirable to plow at all to any depth, if the soil between the two rows is quite mellow, so that the roots and rootlets can push out in every direction, and drink in the fertile water. But if, after planting, the ground is "packed" by heavy rains, it will doubtless be well to plow once with a set of long narrow shovels to mellow up the land again, lest in its compacted condition, dried and "baked," as we say, it would be almost impervious to root growth. But if the middle is continuously mellow, then only the surface should be stirred to a depth of one to two inches, and this by a fine short-toothed harrow or by a sharp fluke harrow, or by a system of sharp steel knives, which, attached to a harrow frame, cut off every starting weed just below the surface of the ground. This shallow cultivation of the ground destroys all the weeds and makes a sort of mellow mulch which lies like a blanket on top of the ground, breaking up the capillary power of the soil, and holding the moisture that is stored in the root bed beneath this blanket so that it may constantly feed the growing plants. This new theory and practice of surface cultivation must commend itself to the practical farmer, since it checks evaporation, catches the rainfall and transmits it to the subsoil and destroys the weeds just as they germinate, thus leaving the whole wealth of fertility in the soil, and leaving also the entire equipment of plant roots unbroken, that they may feed upon this fertility and bring the crop to its fullest and largest perfection.

THE SILO.

By F. A. DERTHICK, Mantua, O.

The introduction of the silo as a factor in modern agriculture has not met with that general favor which its merits demand, and, although an increasing number of dairymen and stock raisers are availing themselves of the advantage of ensilage, the majority is still very large who cling to the older system of dry fodder. This is in part due to the extravagant claims made for ensilage by the early pioneers in the new departure. These enthusiasts insisted that, by some unknown and mysterious process taking place in the silo, the food value of the fodder was increased. Later scientific investigations exploded this fallacy, and thus suspicion was aroused against the system.

The advantages of ensilage have been found to lie in another direction, and that, instead of there being any addition to the food value, there is an actual loss brought about by the conversion of at least a part of the starch and sugar into various acids (lactic or acetic, or both). The Wisconsin Experiment Station after a study extending through a series of years now declares that there is a loss in the nutritive food value of 16 per cent. in both dry matter and protein as against a loss of 24 per cent. on the field dried fodder. It is evident that this slight difference will not in itself justify the outlay necessary for the construction of a silo.

The advantages of the silo may be summed up as follows: Silage furnishes a succulent summer food in winter, thus making it possible and profitable to produce milk during that season of the year when the market is comparatively bare of milk, cheese and butter. This feature alone will prove of incalculable benefit to the dairyman, as it will give a more uniform price for dairy products by withdrawing a part of the surplus of milk from the summer months. Again, the value of silage is supported by economic principles, as the complex changes going on in the silo render the food more digestible and easily assimilated; especially is this true in the case of corn silage. The effect of the moisture and heat of the silo is much like the cooking of food in so far as putting it in the very best condition to be digested. Many insist that the digestive organs of the animal are thus relieved to a greater degree than when the grain is taken to the mill and ground. Silage is also more palatable than dry food and is received with greater avidity by all kinds of stock accustomed to its use. The moist and softened condition of the coarser portions of the stalk, hitherto rejected in great measure, are thus laid under contribution to the food supply of the farm. This is in line with the findings of our scientific friends who claim that the lower portion of the stalk has as great feeding value as the corn itself.

It is not claimed that silage is a properly balanced ration, but it should be supplemented by some food richer in protein. Various tables are given by scientific men as constituting a formula in which the necessary constituents of a nutritive food ration are present. From a large number of inquiries, as well as from observation of the most successful dairymen, the following is suggested as a day's ration: Ensilage, 45 pounds; clover hay, 8 pounds; bran, 5 pounds; oil meal, 1 pound. Total, 59 pounds.

This ration can be furnished at an average of ten cents. There may be those who can figure the cost of the cow's daily keep on dry fodder at as low a point, but it will not be admitted that an equal flow of milk will result or that the animal will be in as good condition. If the above statements be true, they become very suggestive along economic lines. In these days of close competition and struggle to live, it becomes necessary to accomplish the greatest possible results from a given area of land.

A very successful siloist in Erie County gives the cost, including construction of silo, at $1.25 per ton. The silo he builds in the following manner: The studding are two by six, placed about twenty inches apart near the bottom and increasing the distance as the top is approached. These are securely fastened at the corners. Lining is composed of straight-edged boards, one by six, double thickness and breaking joints. Between the two linings is placed thick paper coated with tar. It is further secured by placing a strong beveled piece of timber in each corner, securely fastened. The bottom can be prepared by cementing, or if of stiff clay, used without.

The first silos erected were for the most part of stone or brick, and when stone is at hand it is a question whether such are not cheaper in the end, as they are practically indestructible, not being likely to spread with the pressure or be affected by the acid of the silage.

Numerous attempts have been made to create a prejudice against the silo by charging tainted milk from cows where silage was fed. This charge has never been sustained where the silage was bright and wholesome and fed in moderation. Many of our most fastidious consumers express their preference for silage milk.

A variety of green crops may be used as silage; clover, millet and the soja bean are said to give satisfactory results. It is to corn, however, that we must look for ideal silage. The leaming and mammoth ensilage are more often used than any other varieties. The pioneers made the mistake of cutting the corn too immature, thus missing the best results. The practice now is to cut when the kernel is dented and glazed, yet before fully ripe. In filling the silo, great care should be taken to pack every part of it closely. The corners should receive especial attention. The secret of good silage, like that of canned fruit, is in making it air-tight. The silo should be of such size that one day's feed will require at least two inches from the entire surface of the silo. Shallow silos are to be avoided, as the greater the depth is, the more pressure—a condition which is in every way desirable.

DENDROBIUM VICTORIA REGINA—FLOWERS SLATY-BLUE, WITH WHITE CENTER.

SOME ANATOMICAL PECULIARITIES OF THE HORSE.

By S. R. HOWARD, V.S., Hillsboro, O.

Microscopically considered, the structure and development of the bones of the horse are identical with those of man. His ribs number eighteen on each side, although occasionally he has more. I remember having seen a mule that had thirty-eight well developed ribs, nineteen on each side. The number of molar teeth is given as twenty-four, but I have seen twenty-eight well developed, perfect grinders doing duty. The skull bones, excluding the teeth and bones of the ear, are thirty-eight in number. The bones of a colt's head at foaling time are disarticulated. These, of course, become united in the adult. The skull of man and the skull of the horse are composed of exactly the same number of bones, having the same general arrangement and relation to each other—not only the individual bones, but the very ridges and surfaces for the attachment of muscles, and every hole for the passage of artery or nerve, seen in one can be traced in the other. We find in the adult male horse, midway between the grinders and the incisors, the four canine teeth. Occasionally they are seen well developed in the mare, but usually in her they are rudimentary, are often shed and never replaced. All mares, however, have the germs of them in the chambers of the jaws, and they appear in the majority of old mares. Some authorities claim they have known of these canine teeth in the male to be shed and replaced, but as a rule these teeth appear only in the male horse and are permanent from the time of their first appearance. While these teeth distinguish the sex, their loss would not be felt on that account. If Darwin is correct, these tusks are in the course of ultimate extinction. There is more or less mystery about these tusks, yet they are important factors in the consideration of the problem of the evolution of the horse as well as of other animals. Perhaps in the long ago these teeth served him as weapons of offense and defense.

THE ORANGE THEATER.

APROPOS of the representation of Antigone and the Eumenides recently given at the theater of Orange, a few words concerning ancient theaters, and particularly the one just mentioned, will, perhaps, not be out of place.

Generally speaking, an ancient theater, Greek or Roman, comprised two essential parts: an elongated rectangle designed for the actors and a semicircumference adjoining the longest side of the rectangle and designed for the public.

The long internal side of the rectangle formed the façade. In the Orange Theater this façade was preceded by a portico that is now destroyed, but which doubtless served as a promenade for the spectators and a shelter for the actors. The rectangle itself was divided into two parts. One of these, the proscenium, an elevated platform, extended from the tiers of seats set apart for the spectators as far as to the wall of the stage. Here stood the actors, the choruses and the flute players.

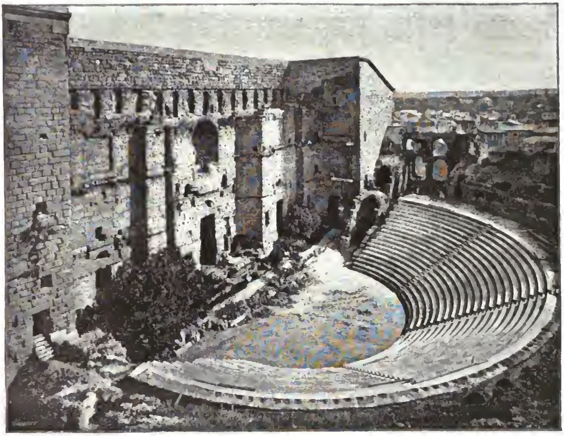
In the rear extended the postscenium, containing the side scenes and the actors' rooms. The stage was provided with three doors that permitted of passing from the proscenium into the postscenium, one of them (the royal door) being in the center and the two others at the sides. In front of the rectangle reserved for the actors unrolled the curtain, or aulaeum, which, instead of rising, as with us, descended at the beginning of representations.

The semicircle set apart for the public was called the cavea, and comprised two parts—at the periphery several tiers of seats and in the center a level part called the orchestra. The seats, to which access was sphinxes, of which fragments have been found. The orchestra was doubtless richly paved. The stage was sumptuously decorated. The central part, the aula regia, must, according to Vitruvius, have given the idea of a palace. In fact, at Orange, marble columns, statues, sculptures and mosaics were used in profusion. In the center of this internal façade, says M. Revoil, in a very interesting lecture, arises a two story motif, forming on the ground floor the aula regia, a large central door surrounded by columns with niches between. On the first story there was the same arrangement for surrounding the large niche in which was enthroned Marcus Aurelius, under whose reign this theater was probably constructed. To the right and left of this central motif extends a three story architectural decoration formed of three superposed Corinthian orders. This decoration is found again upon the sides of the two foreparts of the proscenium, and, on the ground floor, frames the lateral doors on the first and second stories and mosaic medallions over these doors. Friezes enriched with foliage, bass reliefs representing combats of centaurs, eagles, and various attributes added to the richness of the orders of architecture. The stage was protected by a vast sloping ceiling with gilded coppers, and the cavea by an immense purple curtain.

Such was doubtless the magnificent arrangement of the Orange Theater, when, in the second or third century of the Christian era, seven thousand spectators, clad in robes of dazzling colors, applauded the dramas of Sophocles, the comedies of Caecilius or the mimes of Laberius.

Since those fine days the Orange Theater has undergone many vicissitudes. The barbarians in the first place and the Calvinists in the second destroyed or gradually brought the stage and orchestra to light and permitted of the discovery of a large number of fragments. It may be said that he truly rediscovered the Orange Theater. So it is with complete justice that his bust was inaugurated here at the last fêtes.

Other architects have since continued his labors. M. Daumet has restored the cornice of the façade, which was crumbling away, and M. Formigé has occupied himself with the cavea. He has closed up the two apertures that existed to the right and left between the stage and the hall and which left too free a passage for the wind, and has also restored the tiers of seats. The first story, which comprises twenty rows of the latter, has been almost entirely rebuilt. The courses that support the second story are in way of repair. It was but natural that, in measure as the theater was repairing, the idea should occur to place it in a state to be used again for the purposes for which it was primarily designed. As long ago as 1840, M. Ferdinand Michel, a distinguished writer, thought of this, and tells us that at this period he often went to visit it. The keeper of the theater, who was a good declaimer, offered from the stage dramatic tirades that allowed him to judge of the admirable effects of the voice from every part of the auditorium. Gradually M. Michel began to dream but one dream, and that was of giving a representation upon this wonderful stage. This dream was not realized till thirty years later, on the 21st of August, 1869, when he caused "Joseph" (of Méhul) to be represented, along with a piece that he wrote for the occasion: "The Triumphers." In 1874, "Norma," "The Chalet" and "Galatea" were played, and in 1886, M. Mouzin had his "Emperor of Arles" represented twice in succession. It was then that were organized the admira-



VIEW OF THE ROMAN THEATER AT ORANGE.

obtained through arched corridors, were reserved for the public at large. Sometimes corporations or private individuals had their names engraved at the place that they occupied, just as is now done with a churchwarden's pew. One tier found in place in the Orange Theater bears the inscription EQ. G. III, that is to say, Equitum gradus tres, "three rows of knights."

The orchestra was set apart for people of eminence, the public authorities, and the Roman praetor, who occupied the center, seated upon his tribunal.

It is from such general data, obtained especially from Vitruvius and Pausanias, and from a thorough study of the ruins of ancient theaters and particularly the one under consideration, that Auguste Caristie, the eminent architect, has been able to restore the Orange Theater herewith represented.

The southern end of this theater is contiguous to the mountain. The structure is 77 meters in depth. The external façade forms a parallelogram 103 meters in length by 37 in height. On the ground floor this façade presents arcades of Tuscan order. On the first story there is a line of blind arcades, and above there is a solid wall that carries two rows of corbels designed to support the masts of the velarium, that is to say of the immense tent that protected the cavea. The Caristie restoration gives us a very accurate idea of this part of the theater. It comprised three tiers of seats separated by circular landings that served as passageways. Above the third rose a portico that was doubtless set apart for slaves and that crowned these tiers of seats. Between the orchestra and the proscenium extended a large passage parallel with the stage.

The first fifteen rows of seats ended at a wall with projections; upon the first row of which were seated damaged the Roman antiquities. Maurice of Nassau, who was as great a vandal as they, had a fortress constructed in 1622 from materials taken from the arch of triumph and the Orange Theater. A portion of the edifice was even inhabited by the princes of Orange and afterward converted into a prison. The principality of Orange was united in 1660 on French territory. In 1673 M. de Grignan, the son-in-law of Mme. de Sévigné, and then Lieutenant-General of Provence, had the castle of Maurice of Nassau razed. The theater, which served as an outer bastion, was then disengaged, and when Louis XIV came to visit the city he declared that the immense façade of the theater was the finest wall within his kingdom. In fact, it produces a feeling of surprise and admiration. As Mérimée well says, "For the principal elevation, the imposing effect of masses has been sought, and not a delicacy and exactness of details. Grandeur requires no ornaments."

Under the Revolution it was proposed to convert the stage into a vast dungeon, and Millin, the antiquary, was justly indignant at it. The government of the Restoration finally occupied itself with the ruins of Orange, and as long ago as 1824 Auguste Caristie was commissioned to ascertain the state of the theater, and after this restorations were carried on without any break. Constructions covered the whole interior of the edifice and adjoined the exterior; and the occupants had everywhere sapped the walls in order to enlarge the spaces that they had usurped. In certain places the walls had been pierced, and in others their thickness had been diminished by two-thirds. In the presence of the exigencies of these singular proprietors, it required a law to free the theater from these rats and ravens that had taken possession of it. Caristie's excavations ble representations of the month of August of 1888. Boudouresque sang the "Moses" of Rossini, and Mounet-Sully played the "Œdipus Tyrannus" of Sophocles, amid the inexpressible emotion of ten thousand spectators. The magnificent representations that have just taken place, the éclat of which was enhanced by the presence of the President of the republic, have made definitely of the theater a center of artistic and literary pilgrimages—a Bayreuth at once ancient and French.—Le Magasin Pittoresque.

The Russian Ministry of Finances has recently issued a report on the production of platinum in Russia, according to which that country stands first in the world for this production, forty times the quantity produced by all other countries together being obtained there. In the year 1880 the quantity produced amounted to 2,946 kg.; in 1895 it reached 4,413 kg. The production had gone on increasing up to the last year, when it diminished on account of the wet weather in summer. This rare metal is found exclusively in the southern Ural. The manner of its being worked up is unknown in Russia; this is done in Germany, to which country the platinum is exported in a crude state. Whatever Russia requires of worked up platinum it has to buy back from Germany. Of late years the price of this article has run very high: at present it is 900 marks (about £45) for 1 kg. of crude platinum in Russia. On mining for the platinum, the still rarer metal iridium is also found, but only in very small quantities. Last year the total quantity of iridium obtained did not amount to more than 4·1 kg., and this was only slightly exceeded in 1894.

THE SPREAD OF LAND SPECIES BY THE AGENCY OF MAN; WITH ESPECIAL REFERENCE TO INSECTS.*

By LELAND O. HOWARD, Ph.D.

AMONG the many influences which during the last century or two have been affecting that unstable condition of life which is expressed in the words "the geographical distribution of animals and plants," none has approached in potency the agency of man exerted both purposely and unwittingly or accidentally.

Natural spread was for centuries the rule. Species dispersed under natural conditions along the line of least resistance. Winged animals and seeds were spread by flight and by the agency of winds, and at their stopping places thrived or did not thrive, according as conditions were suitable or not suitable. Aquatic animals and plants and small land animals and plants were distributed by the action of rivers and streams and by the ocean itself. Wonderful migrations have occurred, commonly with birds, more rarely with other animals; ice floes and driftwood have carried animals and plants far from their original habitats and even volcanic action has taken part in the dispersal of species. Smaller animals, especially mollusks and insects, and the seeds of plants have been carried many hundreds of miles by birds and lesser distances by mammals.

With the improvement of commercial intercourse between nations by land and by sea another factor became more and more prominent, until in the present period of the world's history the agency of man in the spread of species, taking all plant and animal life into consideration, has become the predominating one. Potentially cosmopolitan forms, possibly even insular indigenes, have by this important agency become dispersed over nearly all of the civilized parts of the globe, while thousands of other species have been carried thousands of miles from their native homes and have established themselves and flourished, often with a new vigor, in a new soil and with a novel environment.

It is obvious that this agency is readily separable into two divisions: a, intentional; b, accidental.

a. Intentional Importations.—Since early times strange plants and animals have been carried home by travelers. Conquering armies have brought back with the spoils of conquest new and interesting creatures and useful and strange plants. With the discovery of America and with the era of circumnavigation of the globe, such introductions into Europe of curious and useful species, plants in particular, increased many fold, while with the colonization of America and other new regions by Europeans there were many intentional return introductions of old world species conducive to the welfare or pleasure of the colonists. Activity in this direction has been increasing and increasing. Public botanical gardens and many wealthy individuals in all quarters of the globe have hardly left a stone unturned in their efforts to introduce and acclimatize new plants, particularly those of economic importance and æsthetic quality, not failing occasionally, it must parenthetically be said, to establish some noxious weed or some especially injurious insect; while it is safe to say that probably the majority of the desirable plants of Europe which will grow in the United States have already been introduced, and that there has been an almost corresponding degree of activity in the introduction of desirable plants from the United States into Europe. In all this host of valuable introductions there have been comparatively few which have turned out badly, aside from failures of establishment. The wild garlic (Allium vineale), that ubiquitous plant which gives its taste to milk, butter, and even to beef during the spring and summer months in many of our States, is said to have been intentionally introduced by the early residents of Germantown, Pennsylvania. The water hyacinth (Piaropus crassipes), originally grown for ornament in a pond near Palatka, Florida, escaped into the Saint John's River about 1890, and has multiplied to such an extent as to seriously retard navigation and to necessitate government investigation. The distribution of the orange hawk weed (Hieracium aurantiacum) a dangerous species which has ruined hundreds of acres of pasture land in New York of recent years, was originally aided by a florist as a hardy ornamental plant. The European wood-waxen (Genista tinctorium) was early introduced at Salem, Mass., in fact about thirty years after the settlement of the colony. It has apparently not been used as a dye plant, but for garden and ornamental purposes only. During the last few years it has become a noxious weed throughout Essex and the adjoining counties. Standing on a rock at Swampscott on July 9 last, the writer was able to see that the country for miles around was colored a bright yellow with enormous masses of this plant. Similar instances are fortunately rare and the majority of our noxious weeds have been accidental introductions.

Intentional introductions of animals, however, have by no means resulted as advantageously as intentional introductions of plants, with the exception of the truly domesticated species, such as the horse, ass, cow, sheep, pig, dog, cat, poultry, honey bee and silkworm of commerce. Even with such species, the grazing ranges of Australia have been overrun by wild horses to such an extent that paid hunters shoot them at a small sum per head, and the European rabbit has become a much worse plague on the same island continent.

Intentional introductions of wild species, however, have almost without exception resulted disastrously.

At various intervals between 1850 and 1867 a few pairs of English sparrows were introduced into our Northeastern States to destroy canker worms, and today this species is a ubiquitous and unmitigated pest throughout all the austral and transition regions of North America, finding its limit only at the borders of the boreal zone, while the place of the injurious insect it was imported to destroy has been taken by another and worse insect pest which it will not touch.

In 1872 Mr. W. Bancroft Espeut imported four pairs of the Indian mongoos from Calcutta into Jamaica for the purpose of destroying the "cane-piece rat." Ten years later it was estimated that the saving to the colony through the work of this animal amounted to £100,000 annually. Then came a sudden change in the aspect of affairs. It was found that the mongoos destroyed all ground-nesting birds, and that the poultry as well as the insectivorous reptiles and batrachians of the island were being exterminated by it. Injurious insects increased in consequence a thousandfold; the temporary benefits of the introduction were speedily wiped away, and the mongoos became a pest. Domestic animals, including young pigs, kids, lambs, newly dropped calves, puppies and kittens were destroyed by it, while it also ate ripe bananas, pineapples, young corn, avocado pears, sweet potatoes, cocoas, yams, pease, sugar cane, meat and salt provisions and fish. Now, we are told, Nature has made another effort to restore the balance. With the increase of insects due to the destruction by the mongoose of their destroyers has come an increase of ticks, which are destroying the mongoos, and all Jamaicans rejoice.

The flying foxes of Australia (Pteropus sp.) are animals which are very destructive to fruit in their native home. Frequently some well-meaning but misguided person will arrive on a steamer at San Francisco with one or more of these creatures as pets. While it is not probable that any of the flying foxes will thrive in northern California or in fact in austral regions, the experience is too dangerous to try, and the quarantine officer of the California State Board of Horticulture has always destroyed such assisted immigrants without mercy.

Less than thirty years ago (in 1868 or 1869) Prof. Trouvelot imported the eggs of the gypsy moth (Porthetria dispar) into Massachusetts. The insect escaped from confinement, increased in numbers, slowly at first, more rapidly afterward, until in 1889 it attracted more than local attention, with the result that in 1890 the State began remedial work. This work has steadily progressed since that time and the State has already expended something over a half million of dollars in the effort to exterminate the insect, and it is estimated that one million five hundred and seventy-five thousand dollars more must be used before extermination can be effected.

Contrast with this a single intentional importation which has had beneficial results. The Australian ladybird (Vedalia cardinalis) was introduced into California in 1889, with the result of saving the whole citrus growing industry of the State from approaching extinction through the ravages of the cottony-cushion scale (Icerya purchasi). Later importations of the same insect into South Africa and Egypt also resulted beneficially.

We have thus had sufficient experience with intentional importations to enable us to conclude that, while they may often be beneficial in a high degree, they form a very dangerous class of experiments, and should never be undertaken without the fullest understanding of the life history and habits of the species. Even then there may be danger, as with a new environment habits frequently change in a marked degree.

b. Accidental Introductions.—The agency of man, however, has been more potent in extending the range of species, and in changing the character of the faunas and floras of the regions which he inhabits by means of accidental importation.

The era of accidental importations began with the beginning of commerce and has grown with the growth of commerce. The vast extensions of international trade of recent years, every improvement in rapidity of travel and in safety of carriage of goods of all kinds, have increased the opportunities of accidental introductions, until at the present time there is hardly a civilized country which has not, firmly established and flourishing within its territory, hundreds of species of animals and plants of foreign origin, the time and means of introduction of many of which cannot be exactly traced, while of others even the original home cannot be ascertained, so widespread has their distribution become.

These accidental importations would at first glance seem to have been more abundant with plants than with animals, since the opportunities for the carriage of seed, especially flying or burrlike seed, and especially when we consider the vitality of this form of the plant organism, are plainly manifold, but I shall later show that possibly even this obvious generalization must be modified in view of the multitudinous chances for free travel which the smaller insects have under our modern systems of transportation.

The agencies which have mainly been instrumental in the accidental distribution of plants are:

1. Wind Storms.—It is obvious that light flying seeds may be carried many hundreds of miles by hurricanes, and may fall in new regions.

2. Water.—This is a very important agency in the distribution of plants upon the same continent, but less important as affecting intracontinental distribution. Still they may be carried by this means from one island to another adjoining island, and when lodged in the crevices of the driftwood, they undoubtedly travel greater distances.

3. Birds.—Seeds are frequently carried great distances by birds. Many of the larger seeds will germinate after passing through the alimentary canal of a bird, and may thus be eaten at one point and voided with the excrement at a widely distant point. It has been shown, for example, that the local distribution of Rhus toxicodendron is greatly affected by the carriage and distribution of the seed in this way by the common crow. Smaller seeds are carried in earth on the feet of birds. Darwin's example of a wounded red-legged partridge which had adhering to its leg a ball of earth weighing 6½ ounces, from which he raised 82 plants of about 5 distinct species, is an evidence of the possibilities of this agency, while his experiment with 6¾ ounces of mud from the edge of a pond which produced 537 distinct plants, an average of a seed for every 6 grains of mud, is still more conclusive.

4. Ballast.—This is the first of the distribution methods which may be combined under the head of "agency of man." The discharge of earth ballast by vessels coming from abroad has been a notable means of distribution of plants by seed. We have just seen how many seed may germinate from a very small lump of earth, and the possibilities in this direction of the many thousands of pounds of discharged ballast are very great. In fact, the ballast grounds in the neighborhood of great cities are invariably favorite botanical collecting spots; they have usually a distinctive flora of their own, and from these centers many introduced plants spread into the surrounding country.

5. Impure Seed.—The great industry in the sale of seed which has grown up of late years is responsible for the spread of many plant species, principally, it must be said, undesirable species. Mr. L. H. Dewey says: "It may be safely asserted that more of our foreign weeds have come to us through impure field and garden seeds than by all other means combined."

6. The Packing Material of Merchandise.—The hay or straw used in packing crockery, glassware or other fragile merchandise is a frequent carrier of foreign seeds. Such goods frequently reach the retailer without repacking, and the hay or straw is thrown out upon the fields or used as bedding for domestic animals and carried out with the manure.

7. Nursery Stock.—Plants are often accidentally introduced by means of seeds, bulbs and root stocks attached to nursery stock or among the pellets of earth about the roots of nursery stock. The extraordinary development, of late years, of commerce in nursery stock has undoubtedly been responsible for the intracontinental carriage of many species of plants in this way.

Instances of the accidental spread of larger animals by man's agency are necessarily wanting. Of the smaller mammals the house rat and the house mouse have been accidentally carried in vessels to all parts of the world and have escaped and established themselves, the former practically everywhere except in boreal regions, or only in its southern borders, and the latter even as far north as the Pribyloff Islands, as I am informed by Dr. Merriam. Small reptiles and batrachians are often accidentally carried by commerce from one country to another, but although there are probably instances of establishment of such species, none are known to me at the time of writing.

Land shells are often transported accidentally across the ocean in any one of the many ways in which the accidental transportation of plants and insects may be brought about, and by virtue of their remarkable power of lying dormant for many months are able to survive the longest journeys. The conditions which govern the establishment of species in this group, however, seem somewhat restrictive; whence it follows that comparatively few forms have become widespread through man's agency, although Binney mentions a number of European species which have been brought by commerce into the United States and have established themselves here, mainly in the vicinity of the seaport towns of the Atlantic coast.

With the earthworms a striking situation exists. It has been shown that, "without a single exception, the Lumbricidæ from extra-European regions are identical with those of Europe; there is not a variety known which is characteristic of a foreign country."* Careful consideration of the evidence seems to show that this is due to accidental transportation by the agency of man.

Comparatively little has been done in the study of the geographical distribution of insects. In the words of Wallace:

"The families and genera of insects are so immensely numerous, probably exceeding fiftyfold those of all other land animals, that for this cause alone it would be impossible to enter fully into their distribution. It is also quite unnecessary, because many of the groups are so liable to be transported by accidental causes that they afford no useful information for our subject, while others are so obscure and uninteresting that they have been very partially collected and studied, and are for this reason equally ineligible."

Nevertheless, the time has already arrived with some groups, and is not far distant even with the others which Mr. Wallace has termed "obscure and uninteresting," when, owing to the indefatigable industry of entomologists as a class, important facts can be gained along distribution lines from the group of insects. Thus it is only within the past few months that the publication of Mr. W. F. Kirby's "Catalogue of the Odonata of the World" has made it possible for Mr. G. H. Carpenter, of the Royal Dublin Society, to prepare a comprehensive paper on the geographical distribution of the dragon flies, a group in which a comparatively few workers have interested themselves. It is in a measure true to-day, as it was entirely true when Wallace wrote, that "many of the groups are so liable to be transported by accidental causes that they afford no useful information for our subject," yet even with the group in which the greatest obscurity as to the original home of the species has existed, owing to a very easy and most frequent commercial transportation—the Coccidæ or scale insects—the continued discovery and characterization of new forms from all parts of the world, and especially of those existing in wild regions, away from the influence of man, are gradually giving us an insight into the probable character of the original coccid faunas of more or less restricted regions.

By reason of the drawbacks mentioned, Wallace considered only "a few of the largest and most conspicuous families which have been so assiduously collected in every part of the globe, and so carefully studied at home as to afford valuable materials for comparison with the vertebrate groups." These groups included 16 families of diurnal Lepidoptera and six of the families of Coleoptera. Even with this restriction among the beetles, however, he must have had some difficulties with the accidental importations, for among the beetles are hundreds of examples of this class of introductions. For example, writing later in his "Island Life," the great naturalist shows that in 1880 the total number of species of beetles known in the Azores amounted to 212, of which 175 were European. Out of these, however, no less than 101 were believed to have been introduced by human agency. Concerning St. Helena he quotes Mr. Wollaston's opinion that 78 of the 203 species have certainly been introduced by the agency of man.

(To be continued.)

Preserving Rubber.—The tendency of becoming brittle which India rubber shows may to some extent be modified by immersing the article in question in a 3 per cent. solution of carbolic acid. Tubing, stoppers, etc., will stand several years' wear without much damage if this precaution is observed.—Der Stein der Weisen.

* Paper read before the Zoological Section of the American Association for the Advancement of Science, August, 1897. A portrait of Doctor Howard will be found in the SCIENTIFIC AMERICAN of even date, page 193.

* F. E. Beddard, Text Book of Zoogeography, Cambridge, 1895, p. 154.

ENGINEERING NOTES.

Messrs. Burmeister & Wain, of Copenhagen, have recently built in their yard an ice breaker, which has broken all records by cutting through ice 22 ft. thick, extending over a mile, says Engineering. The Nadeshny, as she is called, belongs to the Russian government, and will be stationed at Vladivostock. Her length is 180 ft., beam 43 ft., her displacement equals 1,500 tons when 18 ft. in the water aft and 13 ft. forward. With engines indicating 3,000 horse power, a speed of 14½ knots was attained on her trials. The Nadeshny's frames are closely placed and of extra heavy section, the plating being ¾ in., ⅝ in. and 1 in. steel, with considerable tumble home of both sides and ends. Water tanks fore and aft allow considerable alteration of the trim, and by this means the stem can be brought up so as to draw only 9 ft., while the stern can be put down to 22 ft.

Radhanpur is a small native state in North Gujarat, and is at present governed by a British administrator, the nawab being a minor. The state authorities are anxious that their capital may be connected with the outer world by a railway, and are willing to pay for such length of it as will lie in their own territory. It is expected, says Indian Engineering, that surveys will be carried out early next season, with a view to ascertain to what point on the existing railway systems the proposed line from Radhanpur shall be carried. The points so far suggested are Viramgam, on the Bombay, Baroda, and Central Indian Railway's Wadhwar branch, Patan on the Patan branch of his highness the Guekwar's Mehsana Railway, and Deesa on the Palanpur Deesa Railway. It is expected that the necessary surveys will be carried out by the Bombay, Baroda and Central India Railway Company.

The newly constructed ironclad Petropavlovsk will be a valuable addition to the Russian navy, and will prove to be the most powerful vessel in the Baltic fleet. The body of the ironclad has been built in St. Petersburg, on Galerny Island. The armor plates are nickel steel, 10 in. thick, and were prepared in the Ijora Works. Larch wood has been principally used in the construction of the vessel, but her deck is partly of fir and partly of teak. The entire ship's length, including the ram, is 375 ft., the maximum breadth is 70 ft., and the mean draught 25½ ft., and her displacement amounts to 10,960 tons. She is twin screwed, with triple expansion engines of 10,600 indicated horse power, built in England by the firm of Hawthorne, Leslie, & Company. It is calculated that the ship will have a speed of 17 knots. Her armament will consist of four 12 in. heavy guns and twelve 6 in. breechloaders. Besides these, she will carry some Hotchkiss quick firing guns. Four torpedo tubes have already been mounted. Since her stern draught will not permit of her heavy guns being mounted in St. Petersburg, on account of the shallowness of the Neva and the canal, she will shortly proceed to Cronstadt to complete her armament there. It is hoped that the Petropavlovsk will be ready to undergo her trials at the end of September or the beginning of October.

The Aeronautical Journal for July contains among other features an article on "Flight and Flying Machines," by Major Fullerton, R.E., from which we have taken the following: "There are really only two kinds of flight, viz., soaring flight and driving flight, and it is desirable to consider them separately. In soaring flight the only forces acting on the body are its weight and the air; no artificial force acts on it; and flight of this class is based solely upon skillfully combining the weight and air forces. As a consequence, no artificial force whatever, or, in other words, no power, is required for soaring flight, and provided the wind—or air force—is suitable, and proper arrangements are made for combining it with the force of the weight, there is nothing to prevent this class of flight being carried on indefinitely without any artificial aid whatever. In driving flight the conditions are different. Here two forces have to be developed, viz., the sustaining and the driving force. The most suitable way of doing this seems to be to use either a large sustaining surface, as done by Maxim, or to construct the machine on the lines of Phillips, and use a large number of small surfaces, something like the slats of a Venetian blind. Then, in order to sustain the body in a horizontal path, and drive it along with constant velocity—Sustaining force (vertical component of the air force) = weight = W, driving force = horizontal component of the air force = R, and the power required to drive and sustain the body at constant velocity $V = \frac{RV}{550}$ H. P., using the ordinary units of measurement."

The first successful apparatus of which we have any knowledge that burned fuel without the production of smoke was invented by Abu Musa Dschabir Ben Haiyan—better known by the name of Geber—an Arabian alchemist, who lived about the end of the eighth century. He is credited with the discovery of nitric and sulphuric acids, and of certain preparations of mercurial and other metallic salts. Geber called his furnace the Tower of Athanor, and from its construction a steady and uniform heat could be maintained for an indefinite period. Its principal feature, according to Mr. W. F. Durfee, in the Journal of the Franklin Institute, was a high cylindrical tower for containing the fuel. This tower was flanked by two combustion chambers, in or over which the substance or vessel to be heated was placed. These chambers were connected with the central tower near its base by flues, in which were dampers for regulating the flow of the gas generated from the fuel. This furnace of Geber was in fact a "gas furnace," and the general principles involved in its construction were the same as we see in everyday use in all self-feeding base burning stoves, and in many gas furnaces for metallurgical purposes; in fact, many of the so-called improved gas producers are no better and but slightly different from that invented by Geber over 1,000 years ago, and he must be regarded as the discoverer of the great advantages resulting from converting solid fuel into a combustible gas, and then burning that gas in a combustion chamber separate from that containing the solid fuel. Geber's furnace was not a mere suggestion, but was in common use by chemists in all well-appointed laboratories until the beginning of the present century.

ELECTRICAL NOTES.

A railway is to be exhibited at Paris (France) in 1900 which differs from the present style of railways in this respect, that the cars do not move on the rails, but the rails themselves are moved over fixed wheels. The wheels are driven by electricity. A stop must be made for each passenger who wishes to get in or out. The railway will probably be constructed as an elevated road.—Zeitschrift für Architectur.

Electric motor cars are to replace steam locomotives on the Chicago & South Side Elevated Railroad, and when this change is made all the elevated railways in Chicago will be operated by electricity. Work has been commenced laying the third rail under the direction of Mr. E. Klapp, chief engineer, and it is expected that the third rail and feeder cables will all be laid on the structure by the end of November. In the Sprague system of electric traction, which has been adopted, each car will have its own motors, all the cars of a train having electrical couplings, so that the entire train is operated from the front car. On all the other elevated lines the front car only is fitted with motors, and is thus an electric locomotive, the other cars not being equipped with power.

The electric tramways in Dresden are equipped with Siemens & Halske's electric brakes. These brakes act upon the car axle, which is not driven by the electric motor. They are fixed both upon the motor car and upon each of the trailers, and act simultaneously. It is claimed that these brakes act in about one-third of the time of the hand brakes. Trials with both show that the electric brake stopped a car going at a speed of fifteen miles per hour within fourteen yards, while a car with a hand brake going at twelve miles per hour traveled thirty-five yards after the brake was applied. The same electric brakes are used for the line Behrenstrasse-Treptow, at Berlin, says the Electrical Engineer. In this case the brake acts upon the motor direct, and there is no brake upon the trailing carriages. When going at the usual speed these cars are stopped within eight yards.

Although there are several plans to the fore in Sweden about important electrochemical manufactories, to which the abundant water power lends itself admirably, says London Engineering, there are not yet many in operation, the most important being the one for manufacture of chlorate of calcium at Mansbo, where the process used is the one patented by Mr. O. Karlson. The Mansbo waterfall represents the aggregate power of about 5,000 horse power, of which, to begin with, only a small portion was utilized. There were 8 turbines of 230 horse power each, revolving at a speed of 360 revolutions per minute; they have horizontal axes and are directly coupled with their dynamos. The normal capacity of the latter is 1,200 amperes, 115 volts, and they are being worked both day and night. The machines work independently of each other. The current is conveyed from the dynamos to the electrodes, of which the one is of carbon, the other of iron. The original output was fixed at 650 tons per annum, but this has been found altogether inadequate. The installation has, therefore, been extended very materially, and now represents 3,000 horse power and an annual output of some 1,300 tons. The whole installation has cost rather more than $400,000, the cost of machinery and plant being about equal to that of the necessary constructions which were required in order to utilize the water power.

An electric tramway installation is being laid down in Brisbane under the supervision of Mr. J. S. Badger on behalf of the General Electric Company of America. According to the Electrician, the track is laid on sleepers and is chiefly double, the rails weighing from 55 pounds to 83 pounds per yard and bonded with the Chicago bond. The total mileage is about 25½ miles of single track, the furthest point being distant 5,683 yards from the power station. The overhead trolley system is being employed, with side poles and span wires. No. O. B. and S. copper wire is employed for the trolley wire and the majority of the poles are of iron. The feeders are run overhead and are 500,000 circular mils. The boilers are of the Babcock-Wilcox type, and work at 170 pounds steam pressure. The engines are Robey's horizontal compound condensing, with trip gear. The engines have cylinders 17⅝ in. and 30⅝ in. by 40 in. stroke, and are designed for a most economical load of 450 indicated horse power, with 150 pounds steam at the stop valve. They are coupled by leather belting 36 in. wide and 30 ft. centers to General Electric multipolar generators. These generators are of the four-pole type, over-compounded from 500 volts at no load to 550 volts at full load (350 amperes). The cars are propelled by two motors of the General Electric type—25 electrical horse power each—which are fitted to the car with a nose suspension. The cars are fitted with ordinary hand brakes and series parallel controllers.

A very clever mail delivery box has been placed in a number of the larger buildings at Geneva, Switzerland, by an enterprising electrician. This mail box has a compartment for each of the stories of the building, and when the letters are deposited on the ground floor, the carrier delivers them as required. The deposit of a single letter makes an electric contact, which starts a bell going on the respective floor, which does not cease ringing until the letter is taken out. At the same time it opens the faucet of a tank on the roof of the house, which causes water to flow into the cylinder forming the counterweight of the mail box elevator until the weight is heavier than the box, when the box ascends and the flow of water ceases simultaneously. As the box passes each story the mail intended for it—letters, papers and small packages—falls into boxes in the corridor on that floor. This is performed very reliably by a little spring at the bottom of each compartment in the elevator mail box, which causes the bottom of the compartment to catch for a moment, and the release throws out even a single piece of paper thinner than a postal card into the stationary box provided for its reception. When the box has passed the uppermost floor the cylinder filled with water strikes a bolt provided at the bottom, which allows the water to flow out, and by its own weight the box descends to its place on the ground floor. Should by any mischance a single piece of paper have remained in the elevator, upon striking the bottom it will at once go through the same series of movements as before.

MISCELLANEOUS NOTES.

Berlin, the German capital, had its first sidewalk in 1827, on the "Breite Strasse." A private individual put it down before his house, and was honorably commended for his conduct by the king.—Monatsschrift für den Oeffentlichen Baudienst.

Siemens & Halske propose to treat gold-bearing stibnite by dry chlorination, lixiviation with water drying and again subjecting to the action of chlorine gas. After a second lixiviation, the gold is supposed to be mostly in solution. The residue is then treated with HCl, whereby the antimony is converted to chloride, which is dissolved, and the solution electrolyzed, metallic antimony and chlorine gas being produced. The gold is precipitated from the first solutions by electrolysis, or any practicable method.

The Northwestern Lumberman says that a new industry has arisen in Michigan, namely, the conversion of pine stumps into shingles. It is stated that stumps of trees which were cut twenty to twenty-five years ago remain enduring and obdurate obstructions to the cultivation of the soil. They are still sound and turn out excellent shingles when so utilized. This shows the lasting quality of white pine. In the early days of lumbering in Michigan the tree was cut high from the ground, and these old stumps which the farmers are cutting into bolts represent the method of that period. In later years, economy in a material which had become too valuable to waste dictated the cutting of stumpage as near the ground as possible.

The value of foreign books imported into Germany has risen from $2,000,000 to $5,000,000 in the thirteen years from 1881 to 1896. The figures for 1896 are as follows:

Austria-Hungary	$1,800,000
Switzerland	800,000
France	700,000
Holland	400,000
England	400,000
Russia	180,000
United States	158,000
Various other countries	560,000

If we except Austria-Hungary and Switzerland, which publish many works in German, we find that France stands first in the list.—La Vie Scientifique.

How is it that the British exports of Portland cement to the United States have dwindled so much during the last twelve months? For the year ending 1896, the imports in the United States from England amounted to 297,000,000 lb., while for the year ending May, 1897, they were only 174,000,000 lb. In these two periods the imports from Belgium remained nearly stationary, falling only 3,000,000 in a total of 237,000,000, while Germany's contribution has fallen only 73,000,000 in a total of 482,000,000. In other words, while Belgium's trade has diminished less than 2 per cent. and Germany's only 15 per cent., our trade has been reduced nearly 42 per cent., says The Builder. If this reduction is due to increased activity in the building and engineering trades at home, there is no cause for complaint; but if it is due to the better quality and cheaper prices of foreign cement, it is high time that British manufacturers made an effort to regain the lost ground.

The invention of frieze is claimed by a historian of the Netherlands to have been made by the inhabitants of that country, says the Trades Journal Review. They were famous for their A friser or napped cloth. It is possible that the name of the material may have come from its having first been made in Friesland. Later the name was applied to linen, for in 1641 we find, says Fiber and Fabric, linen of frieze mentioned, and in 1671 under the head of linen, "frieze cloth." It appears to have been very early an Irish product. In 1399 "frieze of Coventry" is mentioned. In the sixteenth century this cloth came to be more generally adopted. It is spoken of by one author as a coarse kind of cloth manufactured in Wales, "than which none warmer in winter, and the finest sort thereof very fashionable and genteel. Prince Henry had a *frieze* suit made." An act of 1551 refers to frieze as a Welsh manufacture, and mentions counties which were specially noted for its making. At that time it was made in finer qualities than we usually associate with the material, and men of the highest rank had clothing made of it.

At a recent meeting of the Société de Statistique, Yves Guyot made the following interesting statements concerning industry and commerce in France, says The Engineer. Of French exports, 90 per cent. fall to foreign countries, 10 per cent. to the Colonies. The value of the French home trade amounted to 7,200,000,000 francs in 1896, or 187 francs per head of population, which is about the same as in Germany. The value of the English imports to France amounts to 500,000,000 francs, and the value of exports from France to England 1,053,000,000 francs. Belgian imports to France, 282,000,000 francs; ditto exports, 501,000,000 francs; German imports, 307,000,000 francs, ditto exports, 339,000,000 francs; United States imports, 1,313,000,000 francs; ditto exports, 224,000,000 francs. These four countries consume 61 per cent. of the total French exports, while England alone consumes no less than 30 per cent. On the whole, 7,271,500 tons, worth 3,401,000,000 francs, have been exported, and 22,619,000 tons, worth 3,700,000,000 francs, have been imported to France.

The New York Prison Association will hold an exhibition of articles made by convicts and of prison appliances in its rooms at 135 East Fifteenth Street on October 7, 8 and 9. The exhibition will be divided into groups. In the historical section will be shown pictures and plans of prisons, relics of famous jails and of criminals and crimes. The gallery of portraits of prison keepers and reformers will form part of this section. In another group will be shown models of cells, apparatus used in punishments and executions, police appliances, and forms and blanks showing the organization of prisons. The other sections will be made up of drawings and charts representing criminal types and peculiarities, publications on penology, instruments used in making identifications, literary and artistic work of convicts, and articles made by prisoners. There will be a series of conferences between prison workers while the exhibition is open. Dr. H. E. Allen, the superintendent of the asylum for the criminal insane at Matteawan, will read a paper on insane criminals.

PREVENTING MILK TURNING SOUR.

As soon as the true causes of milk and cream becoming sour or otherwise deteriorating in flavor became known, scientists set to work to discover some means of destroying the bacteria without at the same time injuring the milk. Chemicals of various kinds were tried, but there are objections to the use of all of them. The most successful of all methods of preserving milk and cream yet discovered are those known as pasteurizing and sterilizing. The latter of these is necessary only when milk and cream have to be kept sweet for weeks and months. The two operations, though alike in principle, yet differ in degree. In both, heat is applied to the milk or cream, but not to the same extent. In pasteurization it is necessary to raise the temperature to between 150 to 175 degrees F., and keep it there for about twenty minutes to destroy all active bacteria present. In sterilizing, the temperature must reach or exceed 212 degrees F., that is boiling point. The objection to sterilizing is that it gives a burnt flavor to the product. The pasteurizing process, if properly conducted, leaves no perceptible difference in the taste. As both processes accomplish the object of keeping milk perfectly sweet for a longer period than it would otherwise do, it is clear that for dairying operations pasteurization is preferable to sterilization. The great advantages of treating all cream for butter making by pasteurizing it does not, it is stated by Mr. S. Lowe, seem to be fully recognized in the colonies. In Denmark and Sweden more than 90 per cent. of the butter exported is made from pasteurized cream. During the very hot weather in the Australasian colonies the necessity for this process is most imperative. Artificial refrigeration cannot repair the injury already done to milk or cream by the growth of bacterial life; it can only prevent further injury. If the evening's milk has not been rapidly cooled and kept so during the night, it swarms with bacteria when brought to the factory in the morning, many of them being of the baneful variety, and the cream should be carefully pasteurized; that is, the bacteria should not only be prevented from further increase—they should be killed right off. If the factory manager allows even one farmer's cream which is swarming with evil bacteria to mix with the sweet cream of the rest of his supplies, he will soon discover that the proverb of "ill weeds grow apace" is as applicable to the cream vat as to the garden.

Let us now explain how pasteurization keeps milk sweet for a much longer time than it would otherwise do. The minimum multiplying point of most milk bacteria may be taken at 50 degrees F., the maximum at 113 degrees F. Between these points they multiply in various degrees of rapidity. Thus, while bacteria can live from below zero to about 150 degrees F., they can only multiply from 50 degrees to about 113 degrees F., the temperature most suitable for their growth being 80 degrees F. to 100 degrees F. From this it follows that, if milk be kept below 50 degrees or above 113 degrees, the bacteria in it cannot multiply, though those already existing can at these temperatures carry on their processes of converting the sugar of milk into various acids. Hence, if milk be already swarming with bacteria, it is best to raise the temperature to such a point as will kill them right off, and this temperature, we have seen, is 150 degrees and upward. We have given the pasteurizing temperature as 150 degrees to 175 degrees F. Above this there is danger of producing the burnt flavor previously mentioned. At 150 degrees it takes longer to kill the bacteria than at 175 degrees. At 155 degrees twenty minutes will do, at 160 degrees fifteen minutes, at 165 degrees ten minutes, and so on. Pasteurizing, however, does not kill all bacterial forms. It destroys those that propagate by fission only. It does not kill those that multiply by spores. The baneful kinds, unfortunately, are those which mainly breed by spore formation, and hence are more difficult to kill. In fact, only a sterilizing temperature is sufficient for this purpose. Herein lies a great danger. Unless pasteurized milk is rapidly cooled down to a temperature at which these spores become torpid, pasteurizing is very dangerous, for there is every probability that all the beneficial bacteria will have been killed and only the baneful ones remain alive. Therefore, artificial cooling process must be used along with pasteurization if the best results are to be obtained.—Gardeners' Magazine.

THE

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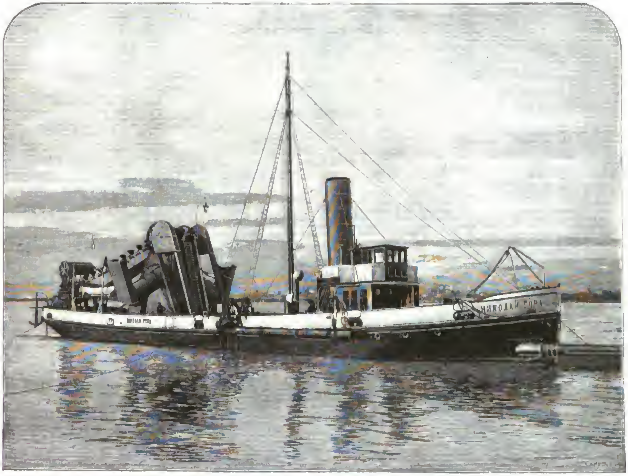
A SUCTION AND BUCKET DREDGER.

THE dredger of which we reproduce two photographs has been constructed by Messrs. A. F. Smulders, of Rotterdam, for use in the ports of the Sea of Azov. It is a suction and bucket dredger, and is provided with two centrifugal pumps for discharging the material dredged up either into barges brought alongside or directly on to the banks. The vessel is 151 ft. long by 27 ft. 3 in. wide, and is 10 ft. 6 in. deep. The maximum draught is about 7 ft. and the speed when fully loaded 8·5 knots. The vessel is constructed in accordance with the requirements of the first class of the Bureau Veritas. It can dredge to a depth of 22 ft. under water, and cuts its own way in the banks. The principal framework of the dredging apparatus is of tubular construction, made of plate 30 in. thick, and angles 3 in. by 3 in. by 0·4 in. The sternward feet of the frame are carried to the bottom of the vessel, the others rest upon a stout beam at the level of the deck. The dredging ladder passes centrally through the vessel, which is divided at the stern for this purpose. It is propelled by twin screws driven by two compound surface condensing reversing steam engines, each of 200 horse power—French. The same engines work the two discharge pumps. The high pressure cylinders are 15 in. diameter, the low pressure cylinders 26¼ in. in diameter, and the stroke is 15¾ in. The dredging ladder is driven by a similar engine. Two marine boilers supply steam at seven atmospheres for these engines. The total heating surface is about 2,300 ft. These boilers, and a small vertical boiler for providing the electric light, etc., are constructed of mild Siemens-Martin steel, and conform with the dimensions required by the Bureau Veritas. At port and starboard there are coal bunkers of 1,765 cubic feet capacity.

The discharge pumps can discharge about 8,830 cubic feet of sand or sandy mud per hour at a distance of 550 yards, raising it to a height of 5 ft., between the discharge orifice and the water level. These pumps will also raise spoil from a depth of 22 ft. by means of a tube lowered at the side of the vessel. Under these conditions it can raise and deliver into barges alongside or at a distance by means of floating pipes at least 8,830 cubic feet of sand per hour. The suction tube can be withdrawn entirely from the water, so that no resistance is offered to the sailing of the vessel.

On the deck is situated all the necessary maritime paraphernalia, and the hoists for raising the dredging ladder. The dredges are lighted exteriorly by two arc lamps, and within by incandescent lamps, and the cabins are heated by steam pipes.—The Engineer.



SUCTION AND BUCKET DREDGER.

[Continued from Supplement, No. 1134, page 18107.]

PERPETUAL MOTION.—IV.*

The celebrated astronomer, James Ferguson, F.R.S., devised the machine illustrated in Fig. 17. It is but fair to state, however, that the machine was designed to show the fallacy of perpetual motion schemes. Ferguson never believed it would move, but maintained that its immobility was a full demonstration of the utter impossibility of a self-moving device.

The axle is placed horizontally, and the spokes turn in a vertical position. The spokes are jointed, as shown, and to each of them is fixed a frame in which a weight, D, moves. When any spoke is in a horizontal position, the weight, D, in it falls down, and pulls the weighted arm, A, of the then vertical spoke straight out, by means of a cord, C, going over the pulley, B, to the weight, D. But when the spokes come about to the left hand, their weights fall back and cease pulling, so that the spokes then bend at their joints and the balls at their ends come nearer the center on the left side. Now, says Ferguson, "as the balls or weights at the right hand side are farther from the center than they are on the left, it might be supposed that this machine would turn round perpetually. I have shown it to many who have declared it would; and yet, for all that, whoever makes it, will find it to be only a mere balance. I leave them to find out the reason."

An old note informs us that "between the years 1700 and 1780 London abounded with perpetual motion seekers and their public exhibitions." Ferguson himself, a mechanician and inventor, would, no doubt, visit many of them, and would see "schemes ingenious, curious, and specious." He did not believe it possible to produce perpetual motion by any contrivance which required the motive power to be within itself (all external agents, such as that of a never-failing stream, the ever-varying pressure of the atmosphere, etc., being ignored). Yet, notwithstanding that, in 1770 he devised this plan for perpetual motion. In his "Commonplace Book," we find a fine pen and ink drawing of his scheme, which he designates as "the most rational scheme," but at the same time declares it to be "downright nonsense." At the conclusion of it he writes: "Whoever makes it will find that it is a mere balance;" from this it may be inferred that the machine was never made—never having had any other existence than that on paper.

W. Stephen claims our notice for drawings which he has left us of his designs for perpetual motion through applications of magnetism, and also of capillary attraction, which we can, however, only treat as early misconceptions, and offer them as a warning against pursuing similar attempts, for it is evident that if such schemes as those were capable of proving anything, the proof could only relate to the perpetuity of the agent, and not of the mechanism sought. A feather retained in a constant current of air would prove quite as much, that is, the constancy of the current as opposed to the inconstancy of the mechanical arrangement when rendered independent of such external agency. Stephen's sketches occur on the paper lining of the backs of a small quarto, entitled "Le Machine," by G. Branca, 1629, in the English Patent Office Library, having a fly leaf inserted on which is written, "W. Stephen's Book, March 10th, 1799."

His first figure, Fig. 18, has the following written on one side of it: "Motion by Magnetism. W. S.—Rep: per duobus N idem tempore quod cessit Attr: apud ☞ et sic aliter et de etc."

That is, the repulsion is twice through N in the same time that the attraction ceases at the ☞, and so on the contrary. This notice is obscure enough, but the next, Fig. 19, marked "Magnets at the end of spiral springs," appears without comment. We can only surmise, therefore, that Stephen expected that the magnet, N, on attracting an opposite magnet, or steel bar, would overweight the wheel, and thus continually present one after the other in succession, in like manner, thereby causing a continuous rotation!

From the works of the Hon. Robert Boyle, vol. v, page 71, we copy an historical account of a strangely self-moving liquor:

An ingenious teacher of mathematics, having occasion to make a composition for a new fire engine, wherof he was to show his Majesty a trial, mingled divers ingredients in an earthen pot over kindled coals; but could not or did not do it so warily, but that the matter took fire, and began to blaze furiously, which obliged him to stifle the blaze as hastily as he could; and having removed the vessel from the fire and suffered it to grow cold, when afterward he came to look upon it, to see if what remained might be of any use to him, he was surprised to find it variously and briskly moved. Wherefore, having set it aside, to be sure that it might be thoroughly cold, he, after some hours, visited it again, and found it move as before; and having cast store of seeds upon it, to see if the liquor would move them also, the bituminous part of it connected them into a kind of thick scum, that covered most of the superficies, but yet left some intervals in which the liquor appeared, and discovered that it continued its motions. Two days after, the engineer discoursing with me of this fire work, about which he had advised with me before, told me, among other things, of this odd accident. And when I asked him if the motion continued still, and had been answered affirmatively, though it was then a dark night and ill weather, my diffidence or my curiosity made me engage him to send for the pot as it was, partly to be sure of the matter of fact and partly to try if the knowledge I had of the ingredients, which he had before told me, would afford any hint of the cause of so odd an effect; a like to which in kind, though not in degree, I had many years before devised, and successfully practiced, the way of producing.

The vessel being come, though the hasty transportation of it seemed to have sufficiently disturbed it, there did appear manifest signs of such a motion as the engineer had ascribed to it, and, therefore, he being willing to leave it with me, I caused it to be set aside in a laboratory, where some furnaces kept the air constantly warm, and did there and elsewhere, at different times, look heedfully upon it, now and then displacing or quite taking off some of the thick scum that too much covered the surface of it, and by this means I had the opportunity to take notice of several phenomena, whereof these are the chief:

1. I observed that the motion of this liquor was not only brisk, but very various, so that having loosened some small portions of the scum, one of them would be carried toward the right hand for instance, and another toward the left, at the same time.

2. Where the liquor first came out from under the scum, it seemed to move the most briskly, flowing almost like a stream whose motion upward had been checked, and, as it were, reverberated by that incumbent obstacle.

3. Several motions in this liquor were the more easy to be observed, because, though it were dark, yet it was not uniform; consisting in part of oily and bituminous ingredients, which, though they seemed to have but one common superficies with the rest of the liquor, yet, by their colors and power of vigorously reflecting the light, they were easily enough distinguishable from

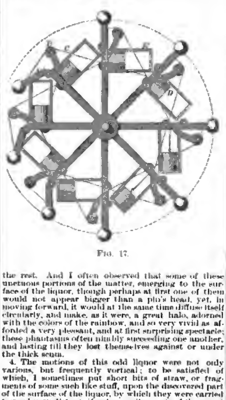
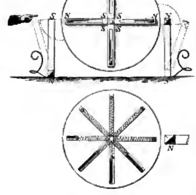


Fig. 17.

the rest. And I often observed that some of these unctuous portions of the matter, emerging to the surface of the liquor, though perhaps at first one of them would not appear bigger than a pin's head, yet, in moving forward, it would at the same time diffuse itself circularly, and make, as it were, a great halo, adorned with the colors of the rainbow, and so very vivid as afforded a very pleasant, and at first surprising spectacle; these phantasms often nimbly succeeding one another, and lasting till they lost themselves against or under the thick scum.

4. The motions of this odd liquor were not only various, but frequently vortical; to be satisfied of which, I sometimes put short bits of straw, or fragments of some such like stuff, upon the discovered part of the surface of the liquor, by which they were carried toward very distant, if not opposite, parts of the vessel at the same time. But to make the vortical motion more evident, I several times detached considerably large pieces of the thick scum from the rest of the body, and had the pleasure to see them move both



Figs. 18 and 19.

with a progressive motion in crooked lines, and with a motion about their own middlemost parts. All this while the liquor, whose parts were thus briskly moved, was actually cold, as to sense.

5. To observe what the presence, or absence, of the free air would do to this liquor, I caused many spoonfuls of it, with some of the scum, to be put into a cylindrical glass, which, though large itself, had a neck belonging to it that was but about the bigness of one's thumb, that it might be well stopped with a cork. But having, by this means, kept the free air from having a full and immediate contact with the whole surface of the mixture, as it had when that mixture lay in the wide mouthed vessel, I could not perceive the liquor to move to and fro, no, not though the orifice of the neck were left open; whereas, having, at the same time, poured some of the liquor into a very shallow and wide mouthed vessel, called in the shops a clear caked glass, it moved rather more than less nimbly and variously than in the great earthen pot (which yet was of the same shape), and showed as many of those vivid and self-dilating circles that have been mentioned in the third number; and these, by the fineness of their colors and the quickness wherewith they succeeded one another, afforded a delightful spectacle as long as I stayed to observe the liquor.

6. Though the motions of the hitherto mentioned liquor did not seem to be always equally brisk, yet they appeared to continue manifest and various in some diversities of weather, as to cold and heat, and when I looked on it by candle light as well as by daylight; and when, not being well enough to visit it myself, I sent one purposely to look upon it, about ten o'clock at night, he brought me word that it continued to move as formerly, and so it has done for ten days; and how much longer it will continue to do so, time must determine.

Postscript.—Some time after the foregoing account had been written, when I came to look upon the liquor (which in the mean time had been several times viewed, and appeared to retain its motions), I found, to my trouble, that somebody's impertinent curiosity and heedlessness had cracked the lower part of the earthen pot; at which overture, the liquor, though not the scum, was run out; which had put a period to our observations, but that, foreseeing that such an accident might happen, I had long before taken out some spoonfuls of the liquor, and kept it close stopped in a vial. By this means I had the opportunity to observe that, when I poured out the liquor into a wide mouthed vessel, it would move as before, though this were done some weeks after it had been put up. And I remember that long after, having one day received the honor of a visit from a foreign minister, who was an inquisitive person and a man of letters, we chanced, among other things, to talk of the liquor; and though it were scarce to be hoped that it could retain any of its motive virtue, yet, to gratify his curiosity, and that of some ingenious men there present, I caused the vial to be brought, and having unstopped it, I poured out the liquor into a convenient shaped vessel, in which, after we had suffered it to rest awhile, they were delightfully surprised to see it move (though not, in my opinion, quite so briskly as before), yet very manifestly and variously. This encouraged me to think it possible that it might retain some motion, though but languid, seven or eight weeks after; and therefore, on the 25th of July, I looked upon it again, and having caused it to be poured into a china cup, it manifested, at first, a brisk and various motion; but this, after awhile, did so slacken that I began to have some suspicion that the motion it was put into by effusion and the first contact of the air might have given it the greatest part of its agitation. But this being but suspicion, I put the vessel into divers postures in a window, the better to discover the true cause of this phenomenon; but while I was busy about this, which engrossed my attention, a mischance overturned the cup, and, by throwing down the liquor, put an end to my speculation; yet this mischance hindered me but from observing how long the odd agitation of our liquor would have continued, but not from finding that it lasted a great while; for I showed it to the foreign minister about or after the beginning of June, that is, about five months or more after the liquor was first observed to move.

Innumerable are the devices by which men have sought to make wheels permanently retain an excess of weight on one side of their centers, while revolving. Our engraving, Fig. 20, illustrates one of these absurd attempts. An endless chain, A, passes over pulleys, B, over the idler pulley, D, and under the idler pulley, C. It is expected that the increased weight of the greater length of chain on one side of the upper pulley, B, will more than counterbalance the weight of the chain on the other side, and also compensate for friction created by the pulleys, and so impart a constant rotation to the pulleys and fly wheel.

The device described is, however, outdone by the one shown in Fig. 21, prepared in 1829, by a correspondent of the Mechanics' Magazine.

This was to be a self-moving railway carriage. The genius who devised this machine thus writes in regard to it:

"In treating of perpetual motion—'that grand secret for the discovery of which those dictators of philosophy, Democritus, Pythagoras, Plato, did travel unto the Gymnosophists and Indian priests'—it would add considerable interest to give some account of its early history. Regarding the fallibility of every contrivance hitherto planned or experimented upon, we may gather sufficient from the writings of Bishop Wilkins alone. The 'little world' of Paracelsus and his followers; the planetarium invented by Cornelius Drebbe, for King James; the 'magnetical globe of Terella,' suggested by Pet. Peregrinus, with the wheel that he, Taisner, and Cardan thought might be kept in motion by 'pieces of steel and loadstones,' are, like the Bishop's own wheel and plummets, and his application of Archimedes' screw, inadequate to the grand end for which they were designed.

"Without enlarging on this head, we shall proceed with the description of a machine which, were it possible to make its parts hold together unimpaired by rotation or the ravages of time, and to give it a path encircling the earth, would assuredly continue to roll along in one undeviating course till time shall be no more.

"A series of inclined planes is to be erected in such a manner that a cone will ascend one (its sides forming an acute angle), and, being raised to the summit, descend on the next (having parallel sides), at the foot of which it must rise on a third and fall on a fourth, and so continue to do alternately throughout.

"The diagram is the section of a carriage, with broad, conical wheels, resting on the inclined plane. The entrance to the carriage is from above, and there are ample accommodations for goods and passengers. The most singular property of this contrivance is, that its speed increases the more it is laden; and when checked on any part of the road, it will, when the cause of stoppage is removed, proceed on its journey by mere power of gravity. Its path may be a circular road formed of the inclined planes. But, to avoid a circuitous route, a double road ought to be made. The carriage not having a retrograde motion on the inclined planes, a road to set out upon, and another to return by, are indispensable.

"I am indebted to a much respected friend for the

* Reprinted from the Scientific American, 1870-71.

hint of this means of effecting a veritable perpetual motion."

"The Perpetual Motion Hunter" is the title of an article in the Imperial Magazine, vol. 6, 1824:

It gives me much pleasure (says the writer) to observe that you notice scientific subjects; you are very right in so doing, as it will not only give variety, but add considerably to the value of your very useful miscellany. It is my humble opinion that such a procedure is infinitely better than filling it with the splenetic effusions of angry minds, the ebullitions of disappointed envy, or, what is worse, dealing out large portions of scandal, and making use of personalities to wound virtuous sensibility, as is the constant practice in some similar publications.

I am now, sir, an elderly man, and am sorry to inform you that I have lost much valuable time, and, of course, money, too, from having been infected, in the early part of my life, with the vanity of hunting after that ignis fatuus called the "perpetual motion." Common report informed me that it would immortalize the name of the inventor; that by it the longitude would be discovered; and that, on this account, the British Parliament had offered a premium of ten thousand pounds for its discovery! This was something like assailing a man at all points at once; the acquirement of such prodigious fame flatters his vanity; and the "ten thousand pounds" could be looked upon in no other light than as the reward of distinguished genius!

Under these impressions I began my career, and pursued it with an ardor which, in any other case, could not have failed to insure me success. I read with the greatest avidity all the accounts of such machines I could anywhere meet with. For a short time I was amused with the ball of iron and the magnet, mentioned in Bishop Wilkins' "Mathematical Magic." I afterward studied the properties of Orffyreus' wheel, which, as Gravesande informs us, continued in rapid motion for two months; at the end of which period it was stopped, he says, to prevent the wear of materials. This astonishing wheel was, you know, destroyed by the inventor, soon after the time of the above mentioned experiment. I endeavored with all my might to recover the long lost secret, and success partly crowned my efforts; for, after a great deal of wearisome labor, I constructed a machine which I then believed would amply compensate the loss which the crazy philosopher had occasioned, when, in a fit of frenzy, he dashed it to pieces. The delight which Newton felt, on discovering the law of gravitation, did not exceed mine when I found that my machine would answer the intended purpose. 'Tis true, it would not put itself in motion—but what then? It was sufficient for the purpose if it would move perpetually when put in motion; and at that time, like many others, I did not quite understand how many requisites were necessary in order that a machine might become a "perpetual motion."

You can scarcely imagine how my heart palpitated when I sent off a description of this, my first invention, to the Board of Longitude. It was a machine which I had no doubt would determine the longitude, both at sea and land, with the greatest ease and accuracy. During the first week, my nightly slumbers were frequently broken by the violent perturbations of my mind; and my day dreams almost continually represented to me the postman knocking at my door with the wished-for letter that was to crown all my hopes. So certain was I of success that I actually began to look about for an estate which the ten thousand pounds were to purchase; for, in my mind's eye, I had it already in my grasp. The humble occupation I had till then followed I now looked upon with disgust; and I saw myself at once elevated to opulence and fame. I waited with patience—yes, Mr. Editor, with all the patience I could muster—but no letter arrived. However,

> "Day presses on the heels of day,
> And moons increase to their decay."

After a few weeks, my mind recovered its wonted serenity, and in about three months more my machine was as free from any violent perturbations as my mind, for at the end of that period, it had completely lost all power, either of perpetuating or continuing its motion. This circumstance occasioned me some uneasiness; and I was not much amused with the taunting remark of one of my friends, who on viewing it exclaimed, "Well! it is a perpetual motion still!" At the end of nine months, I received a letter from the Secretary of the Board of Longitude, informing me of what I already knew—namely, that my machine would not answer.

It is now carefully stowed in my brother Jonathan's garret, at Brigg, in Lincolnshire, where it may be seen by all who are curious in such matters.

I now turned my mind into a different channel. I thought it possible that the object of my search might be accomplished by means of some of the fluids. I considered, with care, the almost continued oscillation of the mercury in the tube of the barometer; but I could deduce from this motion no practical result. I afterward endeavored to turn the tides to some account; but I failed here also. At length, after turning my mind in a variety of ways, as I was one day reading an account of the rise of water in capillary tubes, it at once occurred to me that, as the water rises in such a tube to more than an inch above the surface of the water in the vessel in which the tube is immersed, if I placed the tube in an inclined position, the water would run over its top; and as it would fall into the same vessel, the motion thus produced would be perpetual. At this moment my mind was again agitated; I exclaimed, like Pythagoras, "I have found it! I have found it!" I now supposed myself to be as great a man as any Pythagoras that ever lived. I did not, however, run out, like him, naked into the street; but I remember the discovery was made in the winter season, when I was warmly and comfortably clothed. Had it been in the summer, I cannot tell what might have happened.

I soon procured a capillary tube, and proceeded very carefully to make the experiment; but the water did not flow! Well, said I, this is curious; but a siphon will run: that the water does not run from the top of the tube is owing to the pressure of the atmosphere upon it. I now ordered a capillary siphon, and was again disappointed; for the sluggish water, as if envious of my fame, still refused to move.

Having recovered a little from the stupor into which I had been thrown by the failure of another of my schemes, it occurred to me that if I employed a siphon to carry water over the bank of a river that communicated with the sea, the siphon would run if the outer leg on the outside of the bank was longer than the inner leg; and because the water would find its way into the ocean, and be brought back by the process of evaporation, which is constantly going on, the motion would be perpetual. I could not, however, employ this method to discover the longitude, either at sea or land, and, of course, I was not entitled, from this invention, to the ten thousand pounds.

Another of my machines consisted of two wheels, A and B; the wheel, A, had a number of buckets, at equal distances, round its outer rim. These buckets were so placed that they would each contain a ball of iron. Seven such balls were always on one side of the wheel,

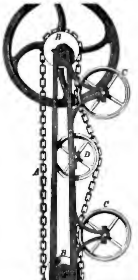


FIG. 20.

A, urging it downward; and one was in the inside of the wheel, B. When the wheel, A, had arrived in a certain position, the lowest ball fell out of its bucket, and rolled down an inclined plane, placed for that purpose, into the interior of B; and then it rolled down another inclined plane into the top bucket of the wheel, A, and so on. This machine had a very specious appearance, and was mistaken for a perpetual motion by thousands of well-informed persons. I need scarcely add that the persons I mention were ignorant of the laws of motion and the theory of mechanics. A similar machine was lately exhibited for a perpetual motion, and a great deal of money made by showing it to the good people of New York, in North America.

My last invention of this kind consisted of an iron wheel and four magnets, similar to the one exhibited some time back in Edinburgh and other places. As the wheel did not move uniformly, and as the power of the magnets soon began to diminish, I suspected it would ultimately fail, and abandoned it altogether. It is necessary to inform you that my modesty—or, rather, my honesty—would never permit me to exhibit any of my inventions for money, as I had always very strong

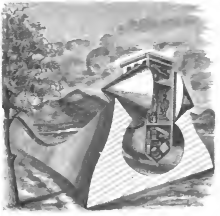


FIG. 21.

grounds of suspicion that they would not answer, and my suspicions were always verified in a short time. It was only after a great number of disappointments that I began seriously to think on the subject. I at first wondered how it happened that my schemes should always prove abortive; but I soon discovered that I was entirely ignorant of the theory of mechanics. Not long after, I had also the mortification to perceive that I had totally mistaken the specific nature of the machine which had been so long the object of my search; so that it would have been next to a miracle if I had found it. I now began in earnest to acquire a knowledge of the principles of natural philosophy, and I very soon found that I had begun at the wrong end of my business.

My misfortunes had created in me serious musings. Yes, said I, in all ages mankind have had some favorite object to pursue—a something bordering on the limits of impossibility. Astrology, or the foretelling of future events, was once the grand charm that led men astray. People are fond of prying into futurity. All men are naturally delighted with what is wonderful; and what pains do they take to deceive themselves! Astrology ruled with despotic sway during the reign of ignorance; but, as knowledge advanced, the chimera retreated; and the few votaries it has now left are ranked either among the most ignorant or the most knavish of all the human race.

Alchemy was another favorite pursuit. To be able to transmute the baser metals into gold was certainly an object of the greatest consequence, and now the discovery would be particularly desirable. There is no doubt that it would be liberally patronized by the ministers of state and the members of the British senate; because, if properly managed, it would enable them to pay off the national debt, and ease the good people of England of the intolerable burden of taxation. In case of such an event taking place, what joy would be diffused throughout the whole of this great empire! The people would be wealthy, and the ministers again able to create places and to give pensions ad infinitum. But I must return to my subject. The search after the perpetual motion is of the same nature as those of astrology and alchemy. It has long amused the ignorant and deceived the credulous; but men of science, properly qualified to judge of its merits, look upon it as a nonentity, and laugh at its proselytes as deluded creatures, who are pursuing a phantom of their own creation.

I have not much hope of being able to convince those persons who are in search of this shadow of a shade that their labors will be fruitless. I will proceed, however, to describe the machine they are endeavoring to construct. The perpetual motion is a machine which possesses within itself the principle of self-motion, and because every body in nature, when in motion, would continue in that state, it follows that every motion, once begun, would be perpetual, if it were not acted upon by some opposing force, such as friction, the resistance of the air, etc. In order, then, to produce a perpetual motion, we have only to remove all the obstacles which oppose that motion; and it is obvious that if we could do this, any motion whatever would be a perpetual motion. But how, let me ask, are we to get rid of these obstacles? Can the friction between two touching bodies be entirely annihilated?—or has any substance yet been found that is void of friction? Can we totally remove all the resistance of the air, which is a force continually varying? And does the air at all times retain its impeding force? They cannot be removed, then, so long as the present laws of nature continue to exist, and who will attempt to destroy them? Besides, it is a well known principle in mechanics that "no power can be gained by any combination of machinery, except there be at the same time an equal gain in an opposite direction;" and must there not be some absolute loss arising from opposing forces, as friction, etc.? How, then, can a perpetual motion be found by any combination of machinery? Another necessary circumstance is, that the motion of any such machine be uniform; for, if it accelerate, it will in time become swift enough to tear itself to pieces; if it retard, it will at length stop. Now, among all the numerous forces acting on machines—forces, too, which are continually varying according to known causes, and to the influence of which every machine is constantly liable—who is there so hardy as even to imagine that a machine can be constructed the motion of which shall be constant and uniformly the same?

There is one perpetual motion, and but one—that is, I know of but one—and that was constructed by Infinite Wisdom. The Divine Creator of the universe has balanced this earth with such exquisite art that its diurnal revolutions are performed so precisely in the same time that it has not varied the hundredth part of a second since the time of Hipparchus, which is now more than two thousand years.

All that we can hope is, that the beams of science will diffuse truth more generally through the world; for, otherwise, dreamers of every kind will continue to dream to the end of time.

(To be continued.)

THE WORLD'S GOLD PRODUCTION.

IT is only twenty years ago, says the New York Journal of Commerce, that an eminent European geologist startled the world by announcing the following conclusions: 1. That the production of gold in the future would have to depend mainly on the output from alluvial deposits. 2. That much more than one-half of the quantity of gold obtainable by the means hitherto employed had already passed through the hands of man. 3. That the time would certainly come, and probably after a few centuries, when the production of gold would cease to an extraordinary extent, and when that metal, on account of its ever-increasing scarcity, would cease to be able to maintain the economic position it had hitherto held. The figures of production seemed to sustain these conclusions. In 1871 the value of the gold mined throughout the world was about $127,000,000; by 1879 it had decreased to $116,000,000; in 1887 was within $106,000,000, and even in 1890 it fell short of $119,000,000. During this time the production of silver was advancing by leaps and bounds. Reckoned at its coining value, the world's production of silver in 1871 was $61,000,000; by 1879 it had touched $96,000,000; by 1887, $124,000,000; and in 1890 it was $162,000,000.

It was not only the discoveries of gold in South Africa that gave a new impulse to the world's production of that metal after 1887. The application of improved processes of separation, both mechanical and chemical, which had done wonders for silver production, was destined to accomplish still more notable results in the increased yield of gold. The cyanide process of gold extraction, which consists in dissolving the gold from ore, concentrates, or tailings by leaching (or agitation) with a dilute solution of cyanide of potassium and precipitating the gold with metallic zinc, dates from 1890. The cost of operating this process was originally $2.40 per ton of ore in bulk, but it was steadily reduced to $1.80 per ton, and has finally reached $1 per ton, and even lower. This and the cognate process of chlorination rendered it possible to work at a profit veins of gold in the sedimentary rocks whose existence, while not un-

known, was regarded as having no practical bearing on the supply of the precious metal. It is very largely due to the application of these processes that it has been possible so to utilize the refractory ores that the world's product of gold in the last seven years has grown from $130,000,000 in 1891 to $180,000,000 in 1894, and now to an estimated $240,000,000 in the present year.

To-day more than 60 per cent. of the world's production of gold is obtained from the solid rock—a proportion not likely to be seriously affected by the yield of British Columbian and Alaskan gravels. The mines of the Rand are producing at the rate of $12,000,000 more this year than they did last, and those of Australia promise to exceed last year's product by nearly $7,000,000. In both cases the sources of supply is almost exclusively crude ores, whose reduction is a question of capital and labor applied in much the same systematic way as prevails in more familiar departments of mining industry. Thus, from being one of the most hazardous of enterprises, gold mining has become one of the safest possible pursuits. The fact has been quoted as indicating the change of public sentiment in regard to the working of the auriferous strata of the earth's surface that established dividend-paying gold stocks four or five years ago might be bought at prices netting the investor from 25 to 30 per cent., while at the present time these same stocks command prices at which the investor realizes only 10 or 15 per cent. In fact, gold mining is being rapidly raised from the level of pure speculation to that of legitimate industry, and as an expert authority has pointed out, with this change has come that careful attention to small economies and to minor improvements in methods and appliances which marks all sound industrial operations.

Under such conditions the only limit to the world's production of gold is the cost of extracting the metal from its baser accompaniments. A tremendous advance was made when the hitherto worthless pyrites which could not be treated by amalgamation were made to yield up their gold contents to chlorination, and when it became possible by the introduction of the cyanide process to obtain almost the last traces of gold from the "tailings" which had been hitherto treated as mere rubbish. The director of the United States mint has stated that under the improved processes of ore treatment only 5 per cent. of the gold is lost. This is not literally true, referring as it does only to the ore crushings ready for chemical treatment. There is scientific authority for the statement that there is a possibility of enlarged profits from increased efficiency equal to an increase of yield of from 15 to 25 per cent. over that attained by the processes in use. The possibility, however, of enlarged profits from the combined effect of reduced working cost and increased efficiency is not arbitrarily limited to any percentage. At the close of last year Mr. Becker, of the United States Geological Survey, found, after actual study of the conditions existing in the Transvaal, that the cost of working a ton of ore might be reduced to about 25 shillings, though the actual minimum was still considerably higher. According to a return of the average yield of ore made by the various companies operating in the Rand, it appears that the amount of gold extracted from a ton varies from 5 pounds sterling to 16 shillings and 6 pence. About a fourth of the companies show a yield per ton of over 42 shillings; there is another fourth below the average, running all the way down to 33 shillings; between that and the point where there appears to be no profit nearly another fourth are operated, and the remaining fourth seems to be worked, so far, either at a positive loss or without any profit at all. The fact remains that there is in the mines of the Transvaal at least $1,500,000,000 of gold yet to be extracted, and that this includes considerably less than one quarter of the known available supply of the world, even before the recent discoveries at Klondike.

ON A SLOW COMBUSTION ARC LAMP SUITABLE FOR FACTORIES AND STREET LIGHTING.*

By W. S. Squire, Ph.D., F.C.S.

According to Mr. W. H. Preece, one-half of the cost of arc lighting is due to the consumption and replacement of the carbons. If in respect of this expense an economy of 50 per cent. could be realized, an important step in advance would be made, still more so, if an economy of 75 per cent. could be obtained. The lamp I am about to introduce to your notice goes much further than that, as you will see presently.

In an ordinary arc lamp the consumption of carbons is usually at the rate of about 1½ in. per hour—1 in. for the positive or upper carbon and ½ in. for the negative or lower carbon, or, say, 40 mm. per hour, both carbons included. This, of course, will vary somewhat, according to the amount of the current. The consumption of carbons in the new lamp (varying also with the strength of the current), and consuming the same amount of electrical energy as the ordinary arc lamp, will be from 1·30 to 2 mm. That is to say, only 5 per cent. of the consumption of the ordinary lamp—an economy of 95 per cent. As this result has been attained by means partly of a mechanical, partly of a chemical character, I thought it a fit subject to bring before a society occupied to a great extent with questions of chemical engineering.

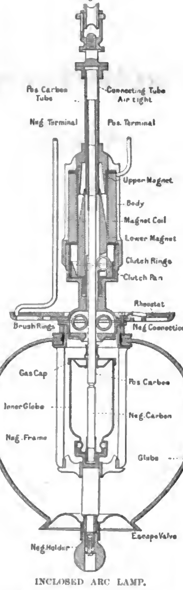
The lamp was invented by an American named Jandus, born in Wisconsin, of Hungarian parents.

I propose in the first place to describe the mechanical construction of the lamp, giving you an opportunity of handling and examining the various parts. I will then have the parts put together, so that you may see the same lamp in action. While this is being done we can consider the chemical side of the question.

Fig. 1 represents the lamp in section. The current enters the lamp by the negative terminal, and then passes through a resistance which has the effect of reducing the voltage (which is in this room 108) down to 81. This is about double the voltage usual for arc lamps. It then passes by the insulated screw shown on the right hand to the lower carbon holder, and so to the lower carbon. It crosses the arc to the upper carbon. It leaves the carbon by the brush rings, and then goes through the magnet coil to the positive terminal.

The magnet coil incloses two cast iron magnets, which I may call the male and female magnets. The female magnet is fixed, but the male is free to move up and down. These will have a tendency to attract one another, and when the current in the coil is strong enough to enable the induced magnetism to overcome the weight of the lower magnet this will rise, carrying with it the upper carbon. The effect of this will be to lengthen the arc, and by increasing the resistance, to diminish the current through the coil, and so arrest the further rise of the magnet. Matters thus remain in equilibrium until, by consumption of the carbon, the arc becomes longer, and the current thereby diminished. The lower magnet then begins to descend. It will be seen that both the fixed and the movable magnet are hollow, and that the upper carbon is not attached to either of them. How then does the movable magnet carry the carbon with it? This is one of the most ingenious contrivances in the lamp. There are three equidistant slots in the lower magnet. In each slot a brass ring is inserted, the rings being prevented from falling out by a wire passing round the magnet. The tendency of these rings is to fall together and clip anything passing in a downward direction, but they will allow anything to pass in an upward direction. By this means the carbon is firmly attached to the lower magnet.

Fig. 1.



INCLOSED ARC LAMP.

If, however, the magnet drops so far that the rings come in contact with a brass plate cut out so as to fit into the slots in the magnet, they are lifted and rolled back so as to allow the carbon to slide down by its own weight between the rings; the moment the normal current is re-established the magnet rises, the rings clutch the carbon, and its further movement is arrested. It is in this way that the upper carbon is gradually fed forward.

A somewhat similar device is employed to make an electrical contact with the upper carbon by means of the brush rings. These do not clutch the carbon at all, but rest gently against it, and being hung in such a way that they are free to turn, they make electrical contact without opposing any sensible resistance to the movements of the carbon. Moreover, they are so placed that the electrical contact is at no great distance from the arc, so that the carbon offers a minimum of resistance, and it is also an unvarying resistance—a point of some importance.

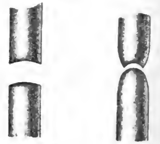
As shown in the drawing, the arc is produced inside a small glass cup, which is closed at the top by the so called "gas cap." This cap has a double duty to perform. In the first place it prevents to a considerable extent the escape of the gases resulting from the combustion of the carbons inside the cup. In the second place it provides for automatically extinguishing the lamp when the upper carbon is nearly exhausted.

The carbon passes freely through the aperture in the center of the cap, but the brass carbon holder cannot pass. As soon as this arrives at the cap the movement is arrested, the feed is stopped, the lamp is extinguished, and no harm can happen to the metal work.

Besides the small glass cup in which the arc is produced there is also an outer globe, which is so fastened by packing to the body of the lamp as to be quite airtight. In this way a layer of highly heated gases is caused to float in the upper part of the outer globe upon the colder gases beneath. This tends to assist the action of the gas cap in keeping the air from the arc. Lastly, the outer globe is closed at the bottom by an escape valve, which opens to let out the gases when expanded by the heat of the arc. Of course, this valve is removed when the carbons are renewed.

It is evident that the arc is produced in a small chamber, to which the possible access of air is reduced to a minimum. Consequently, very little combustion of the carbons takes place. After the lamp has been at work for a short time, almost all the oxygen present in the glass cup has been consumed, and the gases in the cup are found to have the following composition:

Fig. 2.



INCLOSED ARC. OPEN ARC.

Carbon dioxide	1·4
Carbon monoxide	23·6
Oxygen	2·7
Nitrogen	72·3
	100·0

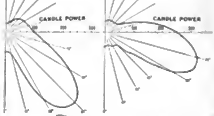
The interior chamber is not, however, perfectly airtight, and diffusion will occur between the gases in the interior chamber and those in the globe outside. Consequently, a very slow combustion of the carbons will go on, while, on the other hand, the gases produced in the interior chamber will diffuse into the outer globe. After some hours' burning the gases in the outer globe are found to have the following composition:

Carbon dioxide	0·8
Carbon monoxide	12·2
Oxygen	12·9
Nitrogen	74·1
	100·0

It is obvious that, in order to produce this effect, the tube in which the upper carbon, with its holder, slides must be perfectly airtight, and the joint between the glass globe and the lamp must also be airtight.

The result of this arrangement is that the carbons burn away very slowly, the consumption never exceeding 2 mm. an hour.

Using carbons of 13 mm. diameter, the upper one having a length of 270 mm., or, say, 10½ in., and the lower one a length of 150 mm., or, say, 6 in., the lamp is found to burn—



OPEN AIR ARC. INCLOSED ARC.

		Hours.
With a current of 4 ampères		220
" " 6 "		160
" " 7 "		120

Consider what this means! When the ordinary arc lamps are used, a man must go up the post every morning and put in fresh carbons. In the case of a lamp burning 220 hours it will be necessary to renew the carbons, on an average, only once in three weeks, say, once a fortnight in winter and once a month in summer. This is not only a great saving in carbons but in wages as well.

The lamp which we have put together has now been burning for about 10 minutes, and the gases in the interior chamber or cup should have the composition I have indicated. I will quickly remove the lower carbon and cup. At the moment that I do so, the highly heated upper carbon as it passes out should set fire to the gases in the cup (experiment performed). You see the carbon monoxide burning with the characteristic blue flame.

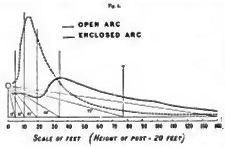
I wish to direct your attention to the way in which

* Paper read before the Society of Chemical Industry. From the Journal of the Society of Chemical Industry.

these carbons burn. In the case of the ordinary arc lamp burning in air, the consumption of the positive carbon, as compared with the negative carbon, is as two to one. In the case of the Jandus lamp it is as four to one, so that the consumption of the lower carbon is practically a negligible quantity. Owing to the lower carbon, in the case of an arc produced in air, burning away at about half the rate of the upper carbon, which is in all lamps fed up to the arc, the point of light is gradually lowered in the globe, so that any devices, such as reflectors, or holophane globes, soon cease to act properly unless there is a special compensating mechanism, usually both complicated and costly. Owing to the very small consumption of the lower carbon in this lamp, the luminous point is practically fixed without any compensating mechanism whatever.

There is also a considerable difference between the shape of the ends of the carbons burning in air and those burning in the Jandus lamp (see Fig. 2). In the Jandus lamp they remain very nearly flat, slightly convex on the negative, slightly concave on the positive. When the carbons burn in air the negative is very distinctly pointed, while there is a sort of crater formed on the positive. This is generally attributed to a transfer of the particles of carbon from one pole to another, but, of course, the forms produced in this way must be perpetually broken down and obliterated by the burning away of the carbons. When there is little or no burning away, as is the case with the Jandus lamp, we should expect to find this production of a point and a crater greatly accentuated, and in an exaggerated form. Nothing of the kind, however, happens; both the carbons remain practically flat, without point or crater. Perhaps we shall have to modify our previous conceptions in regard to this matter.

We have still to consider the distribution of the light over a considerable space of ground. You will say perhaps that the light diminishes according to the square of the distance. Yes; that is quite true of a white hot ball, like the sun, but it is very far from true of the light of the electric arc. The light emitted in one direction is very much greater than that in another direction, and it depends very much what that direction is. Mr. Hesketh, of Blackpool, has been experimenting, both with the Jandus lamp and with an arc lamp burning in air. Figs. 3 and 4 give his results in a graphic form. You will notice that an arc lamp, burning in air, shoots down its rays in such a way that the maximum is attained at an angle of 45° from the perpendicular, while the Jandus lamp attains its maximum at about 75°, that is to say, only 15° from the horizontal. Consequently, while the ordinary arc lamp



brilliantly illuminates objects almost immediately underneath it, and objects at a distance only slightly, the Jandus rays are better distributed over distant objects. Fig. 5 shows the amount of illumination on the ground at different distances. Assuming the lamps to be placed at a height of 20 ft., the ordinary arc lamp produces a prodigious illumination up to 20 ft. or thereabout, but then it rapidly falls off. At 34 ft. it is less than the light of the Jandus, and then it dies away almost to nothing. The Jandus, on the contrary, starts low, owing to the partial shadow of the lower carbon. As soon as we get out of the shadow of the corner of the lower carbon the light increases, and then, owing to the nearly horizontal direction of its maximum, it diffuses its light very equally, and, as you see, it illuminates objects at 140 ft. quite as much as the ordinary arc does at half that distance.

The advantages presented by the Jandus lamp may be summed up as follows:

It will burn on the public mains which have usually a voltage of about 110 without any accessories whatever.

The ordinary arc lamps must either be placed in series or must be furnished with a comparatively high resistance, so as to reduce the voltage to about 40. This means conversion of a good deal of electricity into heat which does nothing but keep the wire of the resistance warm.

The lamp is very economical, the consumption of carbon being insignificant.

The distribution of light is very equable, far more so than in the case of the ordinary arc lamp.

The construction of the lamp is extremely robust. There is no clockwork or delicate mechanism. Probably it might fall from a considerable height without sustaining any other injury than the smashing of the glass.

It is eminently suited for illumination of chemical and other works. It is an essential part of the construction of the lamp that it should be practically airtight. The working parts, therefore, would not be liable to be injured by gases or dust flying about in the factory.

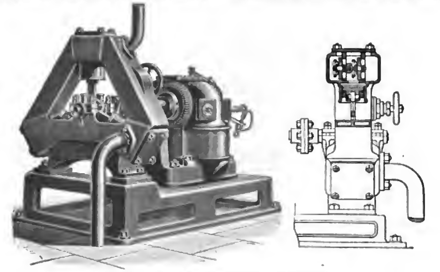
HIGH SPEED ELECTRIC MULTIPLE PUMP.

THE multiple pump represented in the accompanying engravings is of a new type, particularly adapted for use in country houses lighted by electricity. It is absolutely noiseless in its operation, and is capable, not only of being used for raising water to the reservoirs that supply the piping, but may also be provided with an arrangement to permit of accelerating the speed so as to increase the discharge at a high pressure in case of fire.

As may be seen, three pump chambers are arranged symmetrically with respect to the central shaft, which, ordinarily, is coupled directly with the electric motor. These three pump chambers, as well as the valve boxes and the channels for the circulation of water, are cast in a single piece with the triangular frame. Their diameter is relatively great with respect to stroke, which is short. It is thus possible to cause the pistons to operate at a high speed. The pump figured makes 700 revolutions a minute.

The clacks, which are of India rubber, are of special form—one that has already been adopted by the firm for its fire engines. They uncover a wide aperture with a relatively small ascent. In order to facilitate the starting of the electric motor, there is placed between the force and suction channels formed in the frame a by-pass valve cock, through the opening of which the charge upon the motor is rendered very feeble, so that it may be set in motion without giving rise to sparks.

These pumps are constructed in two series, one of which comprises those that are capable of running at two speeds for water and fire service and the other



HIGH SPEED ELECTRIC MULTIPLE PUMP.

those that run at a speed not exceeding 300 revolutions. The following are a few data in regard to these types:

FIRST SERIES.

Water per minute at 300 revolutions,	45, 68, 118, 180
" " " " 600 "	127, 180, 318, 530

SECOND SERIES.

Water per minute at 300 revolutions,	136, 200, 340, 545

The two small models of each of these series are constructed entirely of gun metal, except the frame, which is of cast iron. It is unnecessary to say that any sort of transmission may be used with these pumps, which, aside from the advantage that they possess of operating noiselessly, are remarkable for the constancy of their discharge and the small amount of space that they occupy.—Revue Industrielle.

AN ELECTRIC BAND SAW.

NOWADAYS, when it is a question of machines of a certain power, and that have to produce a large amount of work, an endeavor is made to run them electrically. We have already mentioned a large number of installations of machine tools of this kind, such as windlasses, cranes, lathes, drilling machines, etc., and now purpose making known a horizontal band saw driven electrically, and manufactured by the Société des Machines d'Oerlikon, in Switzerland.

This new machine consists of a bottom frame upon which rest rails and cross pieces designed to hold in position the trunk of the tree to be cut. By reason of the stability of the parts, boards of an absolutely equal thickness are obtained. The two pulleys that carry the blade of the saw are seen in front. Upon one of these pulleys, the one to the right, is placed a 16 h. p. electric motor. These two pulleys, along with the blade of the saw, can be easily raised by the simple motion of a lever and be lowered by means of a hand wheel, according to the thickness that it is desired to give the boards. In front of the apparatus, to the left, may be seen the interrupters. The velocity of the saw reaches about 38 meters a second.

The saw has likewise to move forward with great speed in advancing into the wood. The minimum value of such speed is 11 meters a minute. This motion is obtained through a 6 h. p. electric motor. This saw is capable of performing a large amount of work. In fact, it is easy to place a series of trees in its track so as to have it cut them in passing.

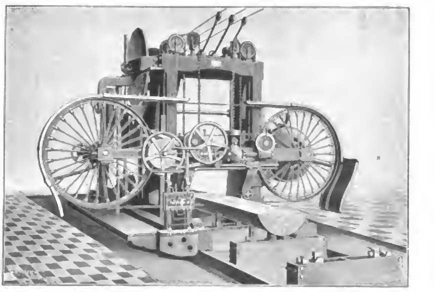
This machine tool has already been utilized in several installations, where it has rendered great services in doing the work of several laborers in a day.—La Nature.

THE USE OF TELEPHONES BY ROYALTY.

AN unaccredited item in one of the daily papers gives the following information, which is alleged to be correct, about the use of the telephone by the "crowned heads of Europe."

Now that Queen Victoria has at length permitted the installation of the telephone at Windsor Castle, Osborne House, Balmoral and Buckingham Palace, there is not a sovereign in Europe who does not utilize this instrument for communicating royal and imperial wishes, as well as commands to subjects and officials. Even the Pope, who has decided that, while a confession may be heard over the telephone, the priest cannot use the wire for the purpose of granting absolution, has had a receiver installed in his private apartments by means of which he often communicates with the Propaganda Fide, which is situated on the other side of the Tiber and at a considerable distance from the Vatican. It is generally his valet, Centra, who does talking over the wire for him, but he occasionally speaks over it himself, and only the other day, when a Jesuit priest was taken suddenly ill during a private audience, the Pope rushed to the little red lined booth and personally called up the Jesuit college, says an exchange.

King Leopold is enabled by means of the telephone



AN ELECTRIC BAND SAW.

to communicate with his ministers at Brussels without leaving his palace at Laeken or his marine residence at Ostend. When, a year ago, the little King of Spain was prostrated with the measles, and secluded at one end of the huge palace at Madrid, the Queen Regent was able to hold intercourse with him, located in a distant wing of the edifice, not only daily, but almost hourly, over the wire.

Queen Victoria, however, is so ultraconservative that it is most difficult to get her consent to any modern innovation, and it was only two years ago she permitted the installation of electric light in the state apartments of Windsor. Previously electricity, as well as gas, had been uncompromisingly barred from her private apartment. Yet it is almost impossible to exaggerate the importance of thus placing the various residences of the Queen in telephonic communication with London, as far as the transmission of official business is concerned.

Until now, whenever the Queen was desirous of consulting one of her constitutional advisers upon any point or when any cabinet minister had some matter of urgency to impart to Her Majesty, the unfortunate dignitary had to travel all the way from Windsor to Balmoral—a twenty-four hours' journey—or to Osborne, which entailed a sea trip across the stormy Solent, very often only for the sake of ten minutes' talk with the sovereign. Then, too, Lord Salisbury and even Mr. Chamberlain, both of them busy men, have had to spend a good deal of their time explaining matters to the Queen in writing.

In the same proportion that the Queen is old-fashioned in her views, in her surroundings, in her manner, and in her appearance, so is the Prince of Wales up-to-date. Marlborough House and Sandringham are fitted up with telephones and electric lights, in the most approved style. Should the prince survive his mother, his advent to the throne is likely to be marked by all sorts of innovations, which will have the effect of simplifying the present intricate manner of conducting the business of state.

In this respect he resembles his nephew, Emperor William II. of Germany, whose predilection for the telephone is a source of disgust to the various government officials at Berlin. There are instruments in his library and working room.

Although it may flatter the pride of the telephone people at Berlin to have the Emperor among the subscribers of the system, yet he gives them far more trouble than any other subscriber. For when he telephones to any of the government departments, the operators at the central office are under the strictest orders to abstain from listening to the conversation.

THE TESTING OF INDIA RUBBER GOODS.

WE have on more than one occasion been approached by buyers of India rubber goods with queries as to some method of ascertaining the quality, even approximately, of their purchases. Something besides chemical analysis is wanted, they say, as such analyses are not only apt to be expensive, but in many cases they do not indicate the presence of any latent evil, such as errors in mixing the materials or in vulcanization. Such faulty workmanship is apt, when the goods are in use, to show itself in an undesirable way, and consequently to lead to passages of arms between buyer and seller, a condition of things to be avoided in the interests of both parties. It is the wholesale buyer who more often finds himself in difficulties in this way, because, although he can generally by strong representation get the goods complained of replaced by the manufacturer, yet such replacement does not obliterate the effects of the evil, as loss of trade resulting from a bad name is not regained all at once. Another great drawback to chemical analysis is that the goods have to be cut up, or, at any rate, cut into, at some point or other to obtain material for the analyst to work upon, and in many cases it means a serious loss to do this. Again, the cutting up of one article of comparatively small value does not conclusively show that the figures obtained from its analysis apply to the whole delivery of which it is a unit, such is the variation that is so commonly found in deliveries of rubber goods. Thus chemical analysis, on the whole, seems out of the question, and it therefore remains to be seen how far physical tests can be adapted so as to give a fair criterion of the quality of the goods and of their suitability for the purposes for which they are intended, while at the same time no damage is done to the articles by the test so as to unfit them for sale. To mention some specific cases, it may or may not be matter of common knowledge that the majority of our leading railway companies submit all deliveries of carriage and wagon buffers to severe mechanical tests, and such as fail to reach a certain standard are rejected. It should be mentioned that such tests are only insisted on by those companies who pay a fair price, and expect to get sound rubber.

At the present time there are great variations in the prices paid by railway companies for goods intended for the same purpose, three times as much being paid in some cases as in others. We doubt the policy of buying cheap and nasty mechanical rubber, but in the light of what has occurred in other branches of the rubber trade, it is gratifying to find that the railway companies who buy such goods do not expressly stipulate that they shall stand the tests usually applied to the best quality. This testing of buffers on a large scale of course takes time, and involves, in addition, the purchase of rather expensive machinery; but there is no doubt that it pays the buyer. Without going into great detail, it may be said that the buffer testing machine is on the principle of the ore stamp, five or six hammers being worked by a cranked axle, and striking blows on as many buffers. The superficial dimensions of the buffer springs are carefully measured before and after the test, which may consist of from 1,000 to 10,000 blows, and may last a whole day. A good buffer should measure the same after as before the test, though one of inferior quality, i. e., wanting in elasticity or badly vulcanized, will be found to have sustained a permanent set after the test. It will be seen at once that this test is of more value than any chemical one would be, and it puts the rubber manufacturer on his mettle, as it is no easy task to get such an equality of vulcanization as is required to conform to the standard of this test. We have known of cases where half a delivery has been returned as unsuitable, though to the best of the rubber manufacturer's knowledge the material and the method of manufacture was similar throughout. We rather suspect that variations occur in the rubber which are not to be detected unless by some such severe test as the one under notice, and which could hardly be discovered in the unvulcanized rubber, though this is a technical matter which does not directly concern us at the present moment. It is necessary to add, however, that, whether owing to this inequality in the elasticity or lasting power of rubber buffers, or to other causes, there seems to be a decided revulsion of feeling in favor of steel springs for rolling stock at the present time, and it behooves the rubber manufacturers to look to their guns unless they wish to lose a considerable business. We append here some figures obtained by a railway company from a delivery of buffers all supposed to be of equal quality, and they show decidedly that some variation either in the quality of the rubber or in the method of manufacture has occurred:

	Loss after Plates. Per cent.	Loss after 10,000 Machine Blows. Per cent.
1	nil	50
2	"	39
3	"	19
4	"	25
5	"	10
1	2	48
2	8	43
3	17	36
4	7	45

The loss after plates, it should be said, refers to the permanent decrease in thickness noticed after the buffers have been screwed up under pressure for a length of time between iron plates, and the percentage of loss refers to the decrease in lifting power or elasticity. For example, a buffer which will lift a weight of 6 tons before undergoing the machine blows and only 3 tons afterward shows a loss of 50 per cent. It is rather exceptional for a delivery of buffers to show such great variations as are given in the table, but the figures show the value of the test from the railway engineer's point of view. Other railway goods, such as vacuum diaphragms, hot water hose, etc., cannot be so easily tested, though a system of testing high pressure steam tubing by attaching two or three lengths to steam jets, and comparing their behavior under pressure, has been adopted with good results, as indicating the temperature and pressure the hose is capable of standing without injury. Leaving the railway companies, we may glance at some points in the specifications sent out by the Admiralty, who are large buyers of rubber goods, and for whose contracts there is considerable competition. The rubber has to be supplied in the form of vulcanized sheets, and it is cut into valves, washers, etc., as required at the various dockyards. Three qualities of rubber are bought, and the exact amount of rubber, mineral and sulphur they are to contain is specified, any variation from the figures given rendering the contractor liable to have the goods thrown back on his hands, a contingency which it is unnecessary to say involves him in considerable loss. The testing employed seems to be almost entirely chemical, and the strictness with which the authorities visit any variation from the limits of sulphur laid down in the specification is carried to a degree which we venture to say is hardly warranted. The idea of a low limit of sulphur is, we suppose, that the goods are less liable to deteriorate when in use by reason of oxidation of uncombined sulphur; but it must not be overlooked that a low content of sulphur necessitates a prolonged vulcanization, and it is extremely doubtful, to say the least of it, whether this prolonged heating is better for the rubber than would be the presence of say an extra one-half per cent. of sulphur, which would lend to shorten the time of vulcanizing.

Some few years ago Lieutenant Vladimiroff, of the Russian navy, made a series of experiments to establish the testing of rubber goods on a sound and satisfactory basis, the following being the main conclusions at which he arrived. It will be seen that the tests advocated are physical ones, as he came to the conclusion that chemical testing gave no reliable results.

1. India rubber should not give the slightest sign of superficial cracks on being bent to an angle of 180° after five hours' exposure in a closed air bath to a temperature of 125° C. The test pieces should be about 6 centimeters thick.

2. Rubber containing not more than 50 per cent, by weight of metallic oxides should stretch to five times its length without breaking.

3. Pure caoutchouc free from all foreign matter, except the sulphur necessary for its vulcanization, should stretch seven times its length without breaking.

4. The extension measured immediately after rupture should not exceed 12 per cent. of the original length of the test piece. The test pieces should be from 3 to 12 millimeters wide and not more than 6 millimeters thick and 8 centimeters long.

5. The percentage of ash gives a certain indication of the degree of softness, and may form a basis for the choice between different qualities for certain purposes.

Any excess of sulphur over that required for vulcanization should be removed at the works, and should not appear on the surface of any object.

Now these tests on the whole seem very well calculated to give useful indication to engineers as to the quality of the goods they are buying, only we would interpolate here the remark that unless a good price is paid for the rubber, it is no use submitting it to such physical tests as these. India rubber substitutes made from oil, and "recovered rubbers," i. e., old rubber worked up again with oil, have nothing like the elasticity appertaining to new sound rubber, and they are quite incapable of standing the elongation or heat tests mentioned. The concluding remark of the lieutenant is somewhat naive, and though no doubt it expresses a desirable consummation, we may perhaps be permitted to ask how it is to be effected. No doubt the excess of sulphur over and above that required for vulcanization should be removed, but how is it to be done? In the case of thin goods, consisting of rubber and sulphur only, it is possible and, indeed, is the regular practice, to remove the excess of sulphur by boiling in a solution of caustic soda, but this could not be done in the case of valves or buffers over an inch thick. Of course the alternative to this is the English Admiralty low limit of sulphur, but, as we have already said, we are not particularly enamored of this, and do not feel inclined to recommend its more general inclusion in rubber specifications.

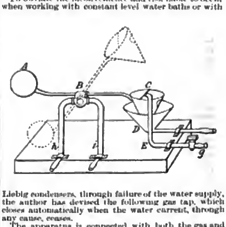
The specific gravity of a rubber compound, or what comes to the same thing, the number of cubic inches to the pound, is very generally taken by buyers as a correct index of the value, though in reality such is often very far from being the case. In the rubber works the qualities of the rubber made vary from floating, the best quality, to densities corresponding to 11 or 12 cubic inches to the pound, the latter densities being in demand nowadays by many consumers with whom price appears to be the main consideration. It will be obvious that such densities as these can only be obtained by utilizing to the utmost the quality that rubber exhibits of taking up a large bulk of added matters.

In Lancashire a common test of mechanical rubber is to throw it into the millpond to ascertain its floating power or otherwise. Of course it is all right as discriminating between a floating and a compounded rubber, but the mere fact of a rubber floating does not show that it is necessarily of a good or elastic quality, because it must be remembered that there may be a large amount of extraneous organic matters present in the form of oil substitutes which are of practically the same density as rubber. By such a test a compound containing a considerable quantity of substitute is found superior to one consisting of the best rubber and 20 per cent. of zinc oxide, a conclusion which would not by any means be borne out in practice. We therefore hold out a word of warning to buyers of rubber goods not to set too much store by this gravity test, as it may very often afford an incorrect criterion of value, though at the same time it is difficult to suggest an alternative test of equal simplicity, or one that does so little damage to the goods. It is, of course, apparent that rubber containing 10 or 70 per cent. of mineral will sink equally in water, and it is useful to extend the test by employing solutions of common salt or chloride of calcium which a rubber of approved density will float in, and samples can be compared with this as a standard at any time. Space prevents our going further into this matter of rubber testing, and we shall conclude with the observation that on the whole what the Russian authority says about the inadequacy of chemical analysis is well founded, and it behooves engineers to work out special mechanical tests easy of application which may serve to convince them that what they are buying is—to use a borrowed expression—of the nature, substance and quality demanded.—Engineering.

AUTOMATIC GAS TAP.

By H. MICHAELIS.

To obviate the inconvenience and risk liable to occur when working with constant level water baths or with



Liebig condensers, through failure of the water supply, the author has devised the following gas tap, which closes automatically when the water current, through any cause, ceases.

The apparatus is connected with both the gas and water supply, and its construction is shown in the accompanying figure.

The gas flows through the tubes, h, i, so long as the lever attached to the tap, B, remains horizontal. This lever carries at one end a weight, A, and at the other a funnel, C. The tube, E, is connected with the water supply, the tap being at g, and through it water flows into the funnel, C, running away partly through a small opening at the apex of the funnel and partly through an overflow opening somewhat below the funnel rim, into the larger funnel, D. So long as the funnel, C, is filled with water—i. e., so long as the water feed continues—it balances the equal weight, A, and the tap remains open. Should the water supply cease, the water in C runs gradually away through the small apical opening, and the weight, A, then bears the lever down until it takes up the position shown by the dotted lines, in which the tap is closed.

The water supply to the funnel, C, may be the overflow from the water bath or condenser. The water must, naturally, be fed into C more quickly than the lower opening in the funnel will allow it to flow into D.

There is also a small hook, not shown in the figure, to hold the lever horizontal, should it be desired to use the burner alone and without the water supply.—From the Berichte in the Journal of the Society of Chemical Industry.

Some tests recently made on molybdenum steel by Prof. W. Von Lipin, of St. Petersburg, show that molybdenum steel resembles wolframium steel in a general way, although it is less affected by annealing and tempering. Annealing makes it softer than wolframium steel; high heating, on the other hand, makes it harder than the latter. This steel can stand treatment in the fire as well as tempering better than wolframium steel, and shows no fissures where wolframium steel very often does. This may be the cause for the numerous attempts to substitute molybdenum for wolframium, and especially chromo-wolframium steel.

ENGINEERING NOTES.

The traffic on the London Metropolitan and Metropolitan District railways for the first half of 1897 amounted to 69,260,675 passengers, says Engineering News. At this rate the total traffic for 1897 would be 138,521,350. In 1896 the actual number of passengers carried was 131,131,305, as compared with 121,063,903 in 1886 and 76,388,117 in 1876. The Metropolitan Railway is a little over 60 miles long, and the Metropolitan District operates about 14¼ miles. The length of line worked by the engines of the first named company is 89½ miles and that of the second is about 36 miles. During the first half of 1897 the aggregate train mileage of the Metropolitan was 1,441,152 miles and that of the Metropolitan District was 765,420 miles. The one company on July 1, 1897, owned 80 locomotives, 400 passenger cars and 242 freight trucks, and the other company owned 54 locomotives, 371 passenger cars and 35 freight cars. The capital expended by the Metropolitan Railway to July 1, 1897, was $61,328,765, while the Metropolitan District had expended to the same time $28,081,065. The net revenue from the first named line for the first half of 1897 was $1,174,290 and that of the Metropolitan District was $627,740.

A curious accident took place in France lately, says The American Architect. On the third of July, an inundation of the River Adour carried away a stone railway bridge at Tarbes. It happens that General Mareille, of the engineer corps of the French army, has devised a form of steel bridge for military purposes, which can be transported in sections, and quickly erected in place; and the railway company applied to the military authorities for a bridge on this system, to serve temporarily, until the stone bridge could be rebuilt. Several of the Mareille bridges have already been successfully used, and sections are kept ready at the army stores, so that on July 17, two weeks after the accident, the new bridge had the rails laid over it, and was ready for testing. The test was made by running a testing train, consisting of two locomotives, with their tenders, and two loaded freight cars, on the bridge. Hardly had the train advanced fairly upon the bridge, running very slowly, when the box girder, of which the bridge substantially consisted, began to twist in the middle, and gave way, throwing the train into the river. Several men on the train were injured, but, fortunately, no one was killed.

There is a strong tendency among bicycle makers in pandering to the public taste for lightness of parts to reduce the size of the sprocket wheel on the rear axle. That this is a mistake is proved by an experiment recently made to determine the comparative efficiency of sprockets of different sizes. To carry out the experiment the bicycle was inverted, and the frame securely attached to the floor. A thin steel band had one end attached to the tire, and the other end carrying a weight which was raised by the band being wound upon the tire, a second weight being hung from a scale pan attached to the pedal, whence the efficiency of the portion of the mechanism transmitting the power could be calculated. A long series of readings were taken with the same large sprocket and with seven, eight and nine toothed sprockets on the rear, and with pedal weights varying from 2 lb. to 30 lb. The average efficiencies in each case were as follows: 7 tooth, 89·9; 8 tooth, 91·5; 9 tooth, 93·4. This shows the 8 tooth to have 98·0 per cent. of the efficiency of the 9 tooth and the 7 tooth to have 96 per cent. of the efficiency of the 9 tooth sprocket, other conditions being equal. The result proves that there is less chain pressure upon the teeth of the larger wheels, and hence less wear.

The friction of bicycle chains is being investigated in the engineering laboratories of Sibley College, Cornell University, under the direction of Prof. R. C. Carpenter, says Engineering News. The question of chainless gearing has also received some attention. The results of the tests so far made are unfavorable to all forms of wheels driven by other means than the usual chain. Prof. Carpenter says: "Our investigations are not entirely completed at the present time, but it seems safe to announce that all the tests indicate that no form of gearing can possibly equal the best chain for efficiency and durability." As a result of tests of chains which had been in actual and severe use, it was found that friction varied from 2 to 5 per cent., depending upon the construction and previous use. The highest friction found was 10 per cent., in the case of an old chain which did not fit the sprocket. The friction of a complete wheel was tested under working conditions in several instances and found to vary from 5 to 40 per cent. of the power applied. For high grade wheels this value ranged between 5 and 8 per cent. In all the tests of bevel gears and geared bicycles the chain gear was found more efficient than the other forms. Another feature adding to the success of the chain in competition with chainless wheels is that the friction remains practically constant at all loads, while with the geared wheel the friction is greatest when the load is greatest.

Milwaukee's use of its fire boats for fighting fire at a distance from the river front is attracting attention in other cities with navigable waters. Cleveland, Detroit and Buffalo have adopted the system, and Boston is preparing to do something with it. In Milwaukee the idea was born of necessity, the first suggestion being for a pipe line from the river to an isolated manufactory in a section where the water mains had not penetrated. The pipe was laid, and the first test with a fire boat at the river end showed a complete success. Since then lines have been laid to cover a great part of the business district of the city. They extend in some instances even as far as 3,000 feet from the river on either side, and have been proved to be effective even with an elevation of 96 feet, and the consequent large back pressure. The chief of the fire department says that a fire boat at the end of a pipe line is worth from three to six engines, according to the length of the line. Therefore, by the extension of the lines at a comparatively small cost, the city has been saved the expense of several engines, to say nothing of the engine houses and the keeping up of companies. The piping costs but little more than the same length of hose, and when laid is practically indestructible. In time at least one-half of Milwaukee will be protected in this manner—a protection more efficient than that provided by fire engines and obtained, moreover, at a minimum of cost.—New York Evening Post.

ELECTRICAL NOTES.

The material most commonly used for the cores of electromagnets is soft iron, on account of its high permeability. But soft Martin steel is often quite as effective and is more easily obtained. It may be used wherever a rapid change of magnetization is not essential. A comparison, undertaken by A. Abt, between two exactly similar horseshoe cores weighing 47 kilogrammes of soft steel and soft iron respectively, gave 0·98 to 1·04 for the ratio of the permeabilities of the former to the latter, and 1·2 to 1·3 as the ratio of the permanent magnetisms. This places soft steel very close to soft iron in magnetic behavior. Cores of steel have the additional advantage over iron of greater tenacity.—Abt, Wied. Ann., No. 8, 1897.

The Plunger, a submarine torpedo boat of the Holland type, designed for the United States navy, was successfully launched at the yards of the Columbia Iron Works, Baltimore, on August 7. The boat is cigar-shaped, eighty-five feet in length and eleven feet five inches in diameter. When floating light, it had a displacement of one hundred and fifty-five tons, and when down to the load line, one hundred and sixty-seven tons. A steam plant is provided to operate twin screws when afloat or awash, and a seventy horse power motor, furnished with current from forty-eight storage batteries, will operate the vessel when submerged. The steam power, electric dynamo and storage cells are so arranged as to be readily reversed, thus making it possible to recharge the cells from the power plant on the boat. The electric power may also be connected to the propeller shaft placed in the axis of the boat, in addition to the connection with the main propeller shaft. The motor may thus operate a special propeller in addition to driving the main shaft independently of the steam engines.

The Street Railway Journal says: "We notice that the Electrical Review, of London, takes exception to the statement of President Clark, of the New York, New Haven & Hartford Railroad, that cars have been operated for hours over sections of his line when both the third rail and service rails were covered with water. The Review evidently thinks that such a thing is impossible and 'a piece of exaggeration that any tyro would detect.' It is true, nevertheless, that such things have happened and can happen, and, in fact, may be expected to happen under such conditions as are found at Nantasket Beach, for it is a fact demonstrated repeatedly in conduit and third rail work that the resistance of rain water or even of water which is by no means chemically pure is sufficiently great to prevent a leakage approaching a short circuit on a line with only five hundred volts pressure. Those who have tested railway plants with water rheostats can easily understand this, knowing the difficulty of forcing a large volume of current through a body of water, unless the plates are placed quite close together; and we may add for the benefit of our doubting contemporary that the recent heavy rains in Connecticut flooded the tracks of the Hartford-Berlin third rail electric road without interfering with operation."

A portable motor and drill, with magnet, for use in iron and steel plants, where heavy castings and forged pieces must be transferred from one department of an establishment to another, is described by Dr. Louis Bell in The Engineering Magazine. The motor is provided with a worm driven drill, together with a universal mounting of four adjustable feet. When placed fairly upon a ship's plate or other mass of iron, these drills have an adhesive force of nearly half a ton each. The drill can be adjusted and clamped by the simple turning of a key, and it will bore holes up to an inch in diameter as fast as it can be safely worked. The whole affair is of only about two hundred pounds weight. Another convenient application of this principle is reported as in use at the works of the Illinois Steel Company. In the rolling of boiler plates, the resulting sheets, twenty or more feet long and weighing from a quarter to half a ton, are, of course, difficult to handle, and, when to be moved, are objects very difficult or inconvenient to sling. To meet this difficulty, a pair of powerful electromagnets were rigged up and attached to the traveling crane, so that all that is now required is to drop these magnets down upon one of the long plates, which is thus held at two convenient points, and to send it rapidly down the room, dropping it into place without a jar.

The Canadian government has submitted formal proposals to this government to establish communication with the Klondike region in Alaska by the construction of a telegraph line from the head of winter navigation on the Lynn Canal to the center of the Klondike region. The proposals have been taken under advisement, says the Electrical World. They have been approved by the British Principal Secretary of State for Foreign Affairs, and were forwarded by the Governor-General of Canada through the British Embassy to the State Department and referred to the Interior Department. The papers are locked up pending consideration. The proposals, while reserving the right of either country pending the settlement of the international boundary line between the United States and Canada, south of Mount St. Elias, urged the expediency of establishing a permanent route giving access to the interior at all seasons of the year. The most feasible route, according to the Canadian authorities, would be to start from the head of the navigation in the winter on the Lynn Canal (the body of water running from Juneau up beyond Dyea and Chilkat), forming part of the present overland route, crossing the mountains by White Pass or by any other pass which may seem more accessible, and proceed northward to Fort Selkirk and thence to Klondike. The Canadian government asserts its readiness to undertake to open communication by constructing a telegraph line from the head of winter navigation on the Lynn Canal, traversing a distance of eighty miles, across the summit of the mountain range to a convenient point northeast of the mountain range, from which a trail can be followed to Fort Selkirk and Klondike. The government also signifies its intention, in case the propositions are adopted, to erect suitable places for shelter at periods from forty to fifty miles along the line, and to keep up dog trains during the months of winter for the conveyance of the mails to and from the interior.

MISCELLANEOUS NOTES.

The old sumptuary laws of the middle ages are called to mind, says The Iron Age, by a singular decree which has recently been issued by the Bulgarian Ministry of Agriculture and Commerce, by virtue of which all the officials and functionaries of the state, of the towns and of the communes in that country, and even deputies when in session, are compelled to wear clothes and boots made in the country, of stuff or leather also produced in the country, under penalty of fine or other punishment. The cloth and leather in the piece must bear a certain mark, which mark must also be found in the made up article. Where the Bulgarian officials have ordered clothes and boots, they are obliged to retain an invoice as a proof, and when buying new clothes, must notify the official in control.

The introduction of a new oarlock for boats is recorded by the Chicago Tribune as involving an additional extension of the ball bearing system in minimizing friction. As described, the rowlocks in this case are of brass, with three point ball bearing, casehardened steel working parts; they are furnished in either polished brass or nickel plated, as may be desired. These materials will not bend or spread, and so the oars will move in them always the same, and thus there can be no liability to uneven rowing on account of the locks being of different shapes and angles, as is not infrequently the case with compositions of a softer character. The statement is made that this ball bearing rowlock affords an ease in rowing which is most remarkable.

The French manufacturers of asbestos goods are supplied from four sources, says the Engineering and Mining Journal: 1. Canada, whence the asbestos is white, silky, very unctuous, having supple fibers from 5 to 25 mm. in length; of all varieties it is that which spins the most easily. 2. Siberia, whence the mineral is yellowish, some species from the straw yellow. The fiber is less flexible than the Canadian, more woody and dry, but stronger. Their length is about the same as the Canadian, but large masses of long fiber mineral are rarer. 3. The Cape of Good Hope asbestos has a characteristic blue color. It comes in larger pieces than either the Canadian or Russian, and their fiber is generally longer and stronger. In spinning or other manipulation, however, it is difficult to handle them, a good deal of the fiber being reduced to powder. 4. In Italy there are different kinds of asbestos, but generally they are little adapted to spinning. There are some long silky fibers of little resistance employed for gas furnaces, and others which are very short and fit only to make heat-retaining coverings.

For ages the English and French controlled the manufacture of hair pins, and it is only within the last twenty years that the goods have been produced in other countries to any extent. The machinery used is of a delicate and intricate character, as the price at which the pins are sold necessitates the cheapest and most rapid process, which can only be secured by automatic machines. The wire is made expressly for the purpose and put up in large coils, which are placed in a clamp and so carried to the machine while being straightened. This machine cuts, bends, and by a delicate instantaneous process sharpens the point. Running at full speed, it will turn out 120 hair pins every minute. To economize, it is necessary to keep the engine going day and night. The difficult part of the work is in the enameling, which is done by dipping the pins in a preparation and baking in an oven. It is here that the most constant and careful attention is required, as the pins must be absolutely smooth and the enamel have a perfect polish. The slightest particle of dust causes imperfections and roughness.—Pearson's Weekly.

The British Liquor Licensing Laws Commission has just issued a report that contains some interesting information about temperance drinks, a subject that might properly interest the United States Treasury Department, not to say American temperance societies. What is called "herb beer" was found to contain 11 per cent. alcohol, a warranted "blue ribbon" drink contained 8 per cent., "parsnip beer" contained 14 per cent., which is more than the beer usually sold in the saloons contains, and even more than that was found in "horehound beer," "bicycling tonic" and "temperance beer." Ginger beer, a favorite temperance beverage, was found to contain from 5¼ to 8¼ per cent. of proof spirit. "And," remarks a British newspaper, in commenting upon the discoveries of the commissioners, "not merely the drinks, but the sweets which more or less innocent children are in the habit of consuming in larger quantities than is good for them, are, alas! not free from alcohol." It is just possible that a great many total abstainers will not thank us for mentioning the alcoholism of drinks hitherto believed to be free from that article. In England the laws allow a 2 per cent. alcoholic beer to be sold without a license.

Almost all the bristles used in this country in the manufacture of brushes are imported, and notwithstanding the increased production of pork in this country, the supply of American bristles is now even smaller than it formerly was. Hogs are fattened and killed young in this country, and with the constant and widespread improvement of the breeds here, the hogs have run less to bristles. Some extensive packers collect bristles, but the American supply is probably less than 1 per cent of the consumption. The longest American bristles are about four and a half inches in length. Imported bristles come from various parts of Russia, but most largely from Poland and North Germany. Some finer soft bristles come from France. The bulk of the supply comes from cold countries, where the hogs are well protected by thick coats, and many of the bristles are those of wild hogs. The hogs shed their coats as many other animals do, and there are men who gather the bristles of wild hogs, knowing their haunts and where the bristles are to be found. Other bristles are collected in the usual manner when the hogs are killed. The bristles are subjected to various processes of curing and preparation before they become commercial bristles and ready for the market. Imported bristles range from three and a half to seven and a half inches in length. Various vegetable fibers are now used extensively in the manufacture of cheaper brushes, but for many uses bristles are indispensable and their importation continues steady.

THE NEW CATHEDRAL IN BERLIN, GERMANY.

SINCE the time of Frederick William IV. of Prussia it has been the desire of the monarchs residing in Berlin to erect a new cathedral for their use on the site of the old church built in the reign of Frederick the Great. On two occasions plans had been completely drawn up, but neither of them came to execution. Now, at last, two and a half million dollars have been granted toward the realization of the present Emperor's desire to accomplish what his fathers were prevented from doing. Professor J. C. Raschdorff and his son, Professor Otto Raschdorff, presented such a plan for the cathedral as was in proportion to the sum granted, and on June 17, 1894, the foundation stone was laid with great ceremony.

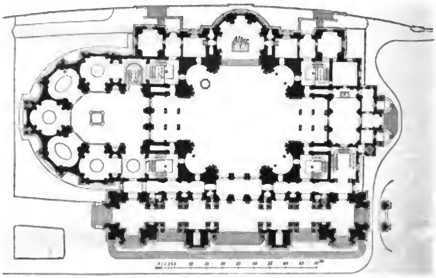
Our illustration, which we take from Ueber Land und Meer, shows the cathedral as it will appear when completed, looked at from the west, on the main façade. From the east façade there are steps leading down to the Spree River. To the royal castle, which lies on the right, the Kaiser Wilhelm's Brücke (Emperor William's bridge) and a street of the same name lead past fine cupola crowned houses, which also can be discerned on our illustration. On the left and right of the Lustgarten (the square in front of the west façade) stand the new museum and the National Gallery. Surrounded by grand buildings on all sides, the new cathedral will stand on one of the finest squares of the world.

We also reproduce from the same source as our illustration an elevation of the church. The longitudinal axis of this is 416 feet in length. In the center the main hall is built in form of a cross, of which the altar occupies the east arm; to the north arm (on the left) is attached the monumental chapel, itself surrounded by five elliptic chapels. Opposite, on the south, lies the chapel for marriage and baptism ceremonies. In the west a corridor runs parallel to the length of the building, connecting the various parts of the church, and leading at either end to a flight of stairs. In front of this corridor is the entrance hall, supported on a number of pillars, and opening with five doors on the steps leading to the Lustgarten.

The baptismal chapel will accommodate some 100 people; it is surmounted by a massive sandstone vaulting, and has a gallery for the choir. The main church has about 2,000 seats. The chancel is placed in the recess on the right of the altar, while the one laterally opposite contains the royal box. The north arm of the cross formed by this central hall is occupied by the organ and choir. High above the hall, 244 feet from the floor, a cupola 104 feet wide sheds its many colored light into the cathedral. A whole church with a good spire could be placed within this central hall. In the walls of the cylindrical structure which supports the cupola there are eight windows, each 32 feet high, which add their light to that given by the cupola. The walls are richly decorated with plastic ornaments. The monumental chapel is intended for the statues and memorials of the Hohenzollerns. The actual coffins are laid below in the vaults which extend under the church. The chapel is lit up by a large skylight in the vaulting, which is 61 feet wide. The walls of the small chapels around are of the most beautiful Mexican onyx, the columns are of red marble. From without the several halls can be distinguished by the appropriate shape of the exterior. Thus the cupola of the main hall rises high above the rest of the building, while on the left and right the baptismal and monumental chapels respectively raise their less pretentious cupolas. The central cupola is surrounded by four towers situated at the corners of the building, of which the front two are 210 feet high and hold the bells.

The entrance to the church is formed by a great arch, with fine columns on either side, over which is placed in a niche a figure of Christ, wrought in bronze, and over 16 feet high. At the same height, on the façade, are figures of the twelve apostles, and at the foot of the two pairs of great columns are grouped the four evangelists and the four great prophets of the Old Testament.

The cathedral is distinguished by its beautiful proportions, its simple grandeur, the perfect distribution and harmony of its mass; all this and the oneness of the building prove it to be the work of no mean artist. To the present time the church is complete up to the cornice. The great cupola has progressed to where the dome begins to spring. The iron frame of this cupola will be put up this year, and it is hoped that in two more years, for the Emperor's birthday in 1900, the whole cathedral will be ready for consecration.



PLAN OF THE NEW CATHEDRAL AT BERLIN.

THE NEW CATHEDRAL AT BERLIN, GERMANY, AS COMPLETED.

NEW GOBELINS TAPESTRY FOR THE EXPOSITION OF 1900.

THE author of this pleasing composition has fully succeeded in giving it the artistic character of the last century, and under the fingers of the skillful artists of the Gobelins the wool will render still better than color the luminous, chatoyant effects of the costumes of the period.

M. Claude has been able to obtain marvelous effects for the general harmony of his work from the pretty fashions of 1792. How far we are here from the monotony of the present costumes, especially on the masculine side! Here, the mayor himself is graceful and showy, with his white powdered wig, his clothing of black taffeta and his scarf worn over the shoulder, and not around the waist. The secretary is clad in apple green silk, and thus introduces a very lively note into the symphony.

As for the bride, she is absolutely ravishing with her hat "à la bergère" crowning a reddish flaxen head of hair. Her frock is of a light rose color, ornamented with all the furbelows of the fashion of the day.

The groom also presents a very fine appearance with his light blue coat, his amaranth knee breeches and his white silk stockings. The guests very harmoniously encircle the principal group.

At the Gobelins there has been taken up the very rational and eminently decorative method followed by the majority of the skillful tapestry workers of the last three centuries.

The tapestries are surrounded by wide borders formed of most fanciful motifs—flowers and fruit, animals, arabesques, etc.

As the "Civil Marriage in 1793" is destined for the Salle des Mariages of the mayoralty house of Bordeaux, the arms of this illustrious city have been very cleverly introduced into the magnificent border.

The city of Bordeaux, as well known, bears the crescent in its coat of arms, not on account of Mussulman sympathies, but simply because of the form of its port. This is why three gracefully interlaced crescents figure at the four corners of the border, in addition to the coat of arms that occupies the center of the upper band.—Le Magasin Pittoresque.

CIVIL MARRIAGE IN 1793—A NEW GOBELINS TAPESTRY.

The first ship having triple expansion engines to enter the transatlantic trade was the Martello, built in 1884 for the Wilson Line by Earle's Shipbuilding Company, of Hull. This ship was 370 ft. long, 43 ft. beam and 28 ft. deep. She had engines with cylinders 35 in., 50 in., and 82 in. in diameter and 57 in. stroke, carried 150 lb. working pressure, indicated 2,400 horse power and made 12 knots on a consumption of 38 tons of coal per day.

[Continued from SUPPLEMENT, No. 1134, page 18130.]

IMPROVIDENT CIVILIZATION.*

A PLEA FOR THE APPLICATION OF SCIENTIFIC METHODS TO THE AMELIORATION OF SOCIO-ECONOMIC DEFECTS AND DISORDERS.

By RICHARD T. COLBURN.

IV. SPENDTHRIFT LUXURY.

TRAVELERS in the Swedish-Norwegian peninsula concur in opinion as to the high general average of thrift and contentment existing, in spite of the uncongenial climate, the paucity of manufactures for export, and the presence of an aristocracy and a considerable standing army. The extremes of riches and poverty are not so great. What a pity that this Scandinavian secret of contentment cannot be made available in our more fortunate lands! True, there is a large consumption of ardent spirits, but the humid climate may account for it, or diminish its worse effects. Then the ratio of illegitimate births is high, but this is not to be charged to moral laxity of the women so much as to restraint laid upon the marriage of the young men by army and church. No very complete explanation of this Utopian satisfaction is offered beyond a pervading high literary standard due to excellent public schools; to a general and steady industry on the part of the whole population, male and female, young and old; and the absence of pretentious and ostentatious displays of wealth. The latter may be due to an anxiety to escape the tax gatherer; but it is refreshing to find one instance where the more liberal education coexists with industry and contentment, which it is fashionable in some countries to regard as incompatible. The same thing is true of Holland, which, however, lays the world under tribute by its floral tubers and Spice Island colonies; but Dutch thrift has made her a solvent creditor nation, and in time of stress she has but to sell her investments to draw from others. Other examples might be cited, Switzerland for one. The lesson to be deduced is the same, that industry, thrift, frugality, are the cure for hard times, for international competition, and contribute to good morals and stability of social order and progress.

Living, or rather working in the commercial metropolis of the continent, where is landed eighty per cent. in value of the importations of fabricated wares, I am continually impressed with the prodigality of our expenditures for things which have little, or only a transient, value. The loss of money, great as it is, is only the smaller part of the injury. It is at least debatable whether it would not be true economy, after having paid for the goods, to throw them all overboard in midatlantic—not at all on behalf of encouragement of home manufacture of similar articles, but to be rid of the pestiferous example and influence. These foreign articles not only keep the nation poor, but also debauch the public taste and conscience, set up false standards of what we can afford, introduce a succession of absurd fashions, and convert what should be stalwart men and women into mere fops and imitators. New York makes its living—a large share of it—in handling these importations, and distributing them widespread over the continent; and the greater its trade of this sort, the more the country is ruined. Its press, of course, from interest, if not from conviction, advocates the greatest freedom of trade, especially of so-called "objects of art," whereon the profits are so large as to leave a wide margin for advertising purposes.*

Consider for one moment what we get: a collection of millinery, bric-a-brac and finery which sooner or later finds its way to the attic or the rubbish heap; then reflect what we part with: the most precious part of our inheritance and labor, the phosphatic and nitrate constituents of the soil which do not quickly reproduce themselves like the ice taken from a lake, but are rather like the marble taken from the quarry. Deforestation may be followed at long intervals by reforestation, perhaps after damage by droughts and floods; the draughts on the fisheries (but not it would seem of the seal fisheries) may be made good by stocking, or by a close season; not so the soil, which must be replenished, or it soon ceases to repay the labor of tillage. Subsoil plowing cannot go on forever and adds to cost. The same cereals and breadstuffs we sell, at bare cost of production, the railroads are compelled to transport at a rate equal only to the train expenses, leaving the burden of interest on cost of construction to be borne by local or domestic traffic. The freight on a barrel of flour from points 1,000 to 1,500 miles inland to Liverpool is but a trifle more than to cart the same across any single city, and much less than to convert it into bread. Indeed, dealers have exhibited in Chicago loaves made of Minneapolis flour, in Glasgow, of the same weight and cost as those produced at the lake port. It only remains to complete the reductio ad absurdum to reimport the Scotch bread in competition with the home-made article. This, however, is what we actually did for years with our cotton and wool fibers, sending them to Europe to be spun into thread and cloth, and would have continued to do so to this day if the arguments of the à priori economists could have prevailed. This is national improvidence; and its logical outcome is national dependence and national impoverishment.

By a provision of the Constitution, inserted at the instance of the more agricultural provinces, an export tax was forbidden to be levied. There has not been as yet much to regret in consequence; but one result is that any advantage which the United States may possess either in climate, soil, or beneath its soil, must be shared with other nations at the cost of extracting and transport. Our Canadian cousins are not so hampered, and are putting an export duty on logs and wood pulp. Russia and America have the great workable petroleum fields, without which the cost of illuminants would have been enhanced. How long these deposits will last is a matter of conjecture, and they are obviously more or less of a speculative investment. While free competition was possible, there was a general rush to empty them upon the glutted market at whatever the oil would bring. The State of Pennsylvania would have been justified in expropriating the entire territory and conserving the product for the benefit of another as well as the present generation. It might do so yet with advantage. The alternative was a combination of small owners into one great excusable monopoly. When this precious deposit is exhausted, we shall have the slender satisfaction of knowing we helped to light and warm the world at no profit to the owners, unless the upbuilding of one or two large estates is to be accounted a compensation. A like history is to follow our depleting reservoirs of natural gas. The same reasons apply pro tanto to the anthracite deposits in a very limited area; parts of five counties in the same State which, with the present ratios of increase, are liable to exhaustion in from 150 to 200 years. Anthracite coal will then be appreciated as a luxury.

We shall be told that it transcends the province of government to dictate what people shall like or dislike, or prescribe what they shall eat, drink, wear, or invest in; that the less it interferes with individual liberty, the better for society, and so on. Partisan as I am of the largest individualism consistent with the equal freedom of others, and the welfare of society, I am loath to appear as the spokesman of social invasion of personal preferences. Our duty to truth obliges us to face the facts; and there are apparently two sides to this question. The protest of Mr. Spencer and his school against such restraints is, however, a claim that one kind of want is as rational and legitimate as another, and is equally entitled to gratification. It is tantamount to saying one man has the natural right to tempt or inveigle another into buying anything he can palm off on him, and if carried to full length would not except minors, imbeciles or inebriates. We know, in fact, that the rule is not universal. The difficulty arises in running the boundaries between restraint and freedom; but daily life and administration of justice consist in drawing such distinctions. The gambler, the lottery dealer, and the pawnbroker desire nothing better than freedom; yet society does interfere with them. The underlying question for students is as to what tastes, cravings, instincts and aims contribute to the good of the race; which of them deserve to be encouraged, and which discouraged, by the state. On what other ground do all civilized nations tax spirits, tobacco and gaming implements?

In this matter of national or race prodigality, take a familiar illustration: The country boy who has been saving up his scanty hoard for a whole year to visit the

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* An address before the Section of Social and Economic Science of the American Association for the Advancement of Science, August, 1897. Mr. Colburn is vice-president and chairman of this section.

* The assumption that in order to sell its own products, a nation must purchase a like amount from its customers is disproved every year by Brazil, which effects triangular exchanges; and by the United States, which liquidates its indebtedness by bank credits, loans and disposals of shares and titles to property. Western Europe has been swapping its fancy articles and superfluities to a tremendous aggregate for evidences of our indebtedness, calling for annual interest and dividend payments and tourists spending money of over four hundred millions. Whenever Congress is disposed to curtail this waste and bring the income and outgo into equilibrium, a chorus of importers and foreign ministers goes up that we are in danger of tariff retaliation. Having brought their emigrating customer to the verge of bankruptcy, they demand as of right a continuance, and resent any attempt on his part to get out and keep out of debt as an affront to themselves. Retaliation may be left to correct itself.

county fair, or it may be a seaside resort, has no well defined idea as to what his purchases will be for the occasion, no list of demands to be supplied; but it is certain as fate that he will part with his cash for what new or striking thing he sees, it may be gingerbread, a coasting ride, or for street fakir's wares. It is just so with the whole national merchandising. At the bottom of every country merchant's list there is, in invisible ink, the further item: Any novelty or trinket in our line that we can sell. A demand such as this is created and supplied by the same act, and articles are being urged and foisted upon callow customers far beyond their natural desires, beyond their proper ability to buy, quite in the manner of heirs to large estates, dupes of crafty cheats.

These views have been forced upon the attention of economists rather than propagated by them. Homilies against riches as hindrances to post-mortem rewards are plentiful enough; but they do little to curb ostentatious or competitive displays. It is not, however, against the truly rich the charge of profligacy is aimed so much as against those who would be thought so; by the masses who entertain the notion that respectability is an affair of outside badges, lavish outlays and make-believe. Prodigality among the rich is responsible for much of this demoralization and apelike imitation. Country homes and city mansions are tolerable, even though for the most part their owners are not living in them but occupying the hotels of both continents. Yachts, racing stables, dog kennels, wine cellars, picture galleries, opera boxes, equipages, banquets, balls, costumes, jewels, are not the delights they are supposed to be by outsiders, but paraphernalia, the implements of a course of tiresome and exhausting exercises which society imposes on its votaries for no well-defined purpose, unless it be to excite the envy of those who cannot afford them, or, an elaborate system of match making and place hunting.

"Shall a man not do as he likes with his own?" is asked. That depends. Who does not know in the ranks of his acquaintance a proportion who, in good times and bad, by a generous table, or in showy hospitality, in dress or furnishings, devour the entire income week by week; people who might be comfortable but who never will be rich, nor yet acquire any competence for old age. The example of their neighbors and the multifarious temptations of the merchants are more than they can stand. Would you then destroy the inducements for acquiring wealth? Well, yes; some of them, at least. As already explained, I would encourage self-denial and thrift on the part of rich, moderate and poor alike, until we as a people get out of debt to others; and after that to establish good roads, comfortable, sanitary homes and pleasure grounds; but not to enter upon a career of vanity and silly ostentation. I am glad to perceive in recent writers on economics a much clearer and firmer note than formerly on vicious luxury.*

V. THE BLIGHT OF PARASITISM.

Under Lycurgus, the pioneer social reformer, the Spartans held property in common. Satisfactory as the experiment was, it cannot be repeated, not even by imperial decree, without a supporting public opinion. To abolish individual property may not be possible now even by revolution, nor does it appear to be necessary or desirable, but some sort of restriction upon acquisition and transmission is desirable. "Can any man," ask the Socialists, "honestly accumulate so much as one million of dollars during his adult lifetime?" A slight acquaintance with either arithmetic or the investment of money at compound interest, or in the profits of trade, or agriculture, or pasturage, will show that he can. The familiar example of the blacksmith, who was to receive for shoeing the horse a penny for the first nail, two for the second, and so on, doubling for the whole series of 32, with a progressive doubling—not a remarkable increase for farmer, trader or stockraiser in each year—proves that he may become the owner of many millions, provided the rate of increase could be kept up for, say, a fifty-year period. The fructifying power of seeds and plants, or of domestic animals, forms the basis of about all the wealth of men and nations, that from mines, quarries and fisheries being inconsiderable. To a man not in either pursuit, it is practicable, as I personally knew a teacher to do, to lay aside one dollar per day between twenty and seventy, investing in good mortgages (formerly yielding seven and six per cent.) and the total is surprising to one who has not made the calculation, every dollar of it lawfully and honestly earned. The clamor against millionaires as such, which disgraces much of our social science literature, to say the least, is out of place. The more of them, the better—unless it can be shown that they have engrossed what belonged to others; or their use and disposition in some way contravenes the general welfare. It ought to be added that the rates of interest now being lower, five and four instead of seven and six per cent., and the profits from merchandising, farming, grazing and many forms of manufactures and transportation being halved and quartered by the competition of the larger surviving concerns, the chances of becoming a half millionaire by mere saving, without resort to speculation or usurious rates of interest, are much more remote.

Suppose we take, instead, the case of a person—it may be a bright, capable young man, a young woman, or even an imbecile ward, under guardianship—who inherits so moderate a sum as $10,000 during infancy, who, if he is fortunate enough to have guardians of judgment and probity—such a one may unknowingly become a millionaire without labor or economy. If one were able to add to this store further savings, and escape severe losses, the fortune might become very large, without encroaching on the rights of borrowers or lenders.

It is an interesting inquiry raised of late by the movement in favor of taxing inheritances now sweeping from one State to another, whether such an inheritance is honestly obtained, or if so, whether it is for the best interests of society that it so passes by descent or gift to direct or collateral heirs. The answer to this class of questions is not to be derived deductively from moral or legal maxims, but from observation in practice. The reasons for a change in the policy of inheritance and descent of large estates I have already presented to the section, at some length, and may be briefly summed up as follows:

First.—Under the régime of free competition, the desire to accumulate great wealth is not only laudable, but necessary. Business and investments are by it turned into precarious lotteries. An excess of care and fortune becomes necessary to guarantee maintenance during decrepitude, the rearing of surviving children, and support of relicts, all of which might be accomplished with less capital if more complete assurance could be had. This I am persuaded ought to be and can be furnished by the State.

Second.—The further desire to secure by testamentary disposition for offspring more than an even chance in life by setting the sons up in business, or of leaving portions or dowries to the daughters after death is neither so necessary nor so laudable, if we judge by the results. It cuts the nerves of self-reliance and engenders a feeling of "great expectations," of rewards that have not been earned; it encourages parasitism and creates sharpers and their dupes, stimulates fortune hunters, and multiplies marital misery. Besides, it is contrary to good morals and sound policy to hold out the hope of advantage through the death of another, whether he be of near or remote kin. The profligacy of heirs to large fortunes, the demoralization and degeneracy of spendthrifts and their retinue need no amplification. As a contrivance to secure the marriage of daughters, it is remarkable at present chiefly for the success of the money bait in attracting the needy or degenerate holders of titles to nobility, and is no improvement on the plan mentioned by Herodotus where the more comely maidens were annually bid for at auction, the premiums going to the less attractive to whatever extent was necessary to secure a consort.

Third.—The difficulties attending succession are by no means so trifling as they may appear to those who are not put to the trouble. Public sentiment, following custom long established, dictates that a man's possessions shall be divided among his own children and blood relatives, with a reservation in favor of his widow, if there be one; and the statutes have been framed on that policy in cases of intestacy. The courts are more and more inclined to interpret ambiguous phraseology to that end, and to annul wills, or portions of wills, to the contrary tenor, except upon the clearest declaration of intention and choice of instrumentalities. This is an attempt to curtail that plea of "undue influence" which forms the basis of most testamentary contests, and which breeds scandals, family quarrels, and wasteful litigation. In olden times there was hardly a possibility of a large estate being passed without a liberal slice to the church, and many States have expressly limited the share which may thus be awarded to those not of kin or to eleemosynary institutions; others have suggestively forbidden bequests to priest, doctor or counsel in attendance during the last illness.

The draughting of probated wills reveals a disposition to withhold the principal sum from children, for which trustees are appointed, giving merely the income, the capital going to the grandchildren as being perhaps less likely to misuse it than their parents.

Fourth.—The bequests to charity, though undoubtedly in many instances perverted to founding and maintaining useless sinecures, are not so numerous nor so large as to constitute a menace to society. Contrariwise, they should be encouraged and made more general, and be more effectively carried out. At the same time the attitude of mendicancy is not favorable to manly independence or intellectual vigor, either on heirs of the blood or on institutions (unless scientific research be an exception). Philanthropic aims may be rendered more certain either by concentration into systematic method or by oversight and positive regulation from an exterior authority. It is a hopeful sign that the endowments, formerly going exclusively to churches and missionary efforts and the like, are now going more and more to technical and scientific institutions.

Fifth.—I need not discuss here the power, or the wisdom, of taxing legacies by the State; it is here, and promises to remain and grow. The only question for the sociologist now is: Shall the very considerable revenues derived from these sources be mingled with the general treasury and be expended for any or all State purposes, as in New York and many States; or, shall an effort be made to segregate this money and dedicate it to special purposes of benevolence, charity, and embellishment, thus to invite and, if wisely carried out, to win in advance the consent of the owners of large properties? I believe it is in the power of law, and within the compass of economic skill, to provide a residuary legatee for every such person superior to any other he could choose or contrive for himself, so that, in fact, it would practically make no difference whether he executed a will or not; or, if there were any difference, that the machinery provided by the State would be more sure to meet his views than any he could select. Nothing would prevent him from distributing his estate during life, if he felt so inclined; but, on the other hand, a portion of all beyond what was necessary to a competence to infants, to the disabled or incompetent, would be turned over to a department of beneficence, managed by skilled men, as are our State universities and the Smithsonian Institution, who should organize and methodize the philanthropic impulses of the rich with the ample revenues at command much better than the haphazard litigious course now open to them.

Sixth.—The same agency thus intrusted with the dispensing of voluntary as well as involuntary bequests might be availed of to do away with much of the necessity for hoarding or amassing riches, and to strip from great wealth some of the dangerous or mischievous homage paid to it, which is the cause of so much friction and clashing in lives that otherwise might be serene. Annuities might be granted for the life of the purchaser or for the life of others, objects of his care and solicitude, and thus help to banish in large measure the fear of the wolf at the door. The vicissitudes of business and health, the disappearance or loss of friends, the impatience of consanguines with enfeebled dotards, are all real causes for morbid acquisitiveness, and these might be banished by a pension or competency for life. Steady, though moderate, income is conducive to longevity, sanity and tranquillity.

By such means the benefactor who is frequently at a loss what to do with his possession could have the double benefit of using it up, or all that was of any real use to him, and at the same time of seeing the remainder of it devoted (without the scandalous shrinkage which now attaches to many of our pet charitable societies) to the erection and conduct of hospitals, asylums, reformatories, libraries, Carnegie and Cooper Institutes, memorial statues and edifices, public parks and promenades, music halls and pavilions. I hold it certain that the most avaricious of heirs would sooner see the contested wealth expended in such a judicious manner than on court costs, lawyers' fees, and the like, or than given to the opposite side. If it be objected that inheritance taxes will be evaded by gifts during life, it is easy to see that this is one of the objects aimed at—to coerce rich men and women to dispose of their excess beyond the line of competence, and to see the good or ill it works and not leave this task wholly to surviving society. There ought to be a narrower limit drawn around the power of the dead hand. Because of the sagacity to amass a fortune, there is no reason in nature why that fact should carry with it after death an authority greater than to the living.

VI. THE RÔLE OF SUPERSTITIONS.

Here let me say, we speak commonly of the sciences as if they were so many separate and independent fields of work, with distinct boundaries between them; and the division of these studies into so many different chairs in our universities, and our own classification under ten or twelve groups or "sections" tends to confirm this supposition. It should be understood that science is systematic knowledge, and the pursuit of knowledge according to methods admitting of demonstration or reasonable certainty; and that each portion is not only interlaced with its near neighbor, but all are more or less blended and interdependent, so that any great advance in one affects the others, and, of course, any backwardness keeps back the near related parts.

The old conception of science as a pyramid, whereof languages, mathematics and geometry were the basis and philosophy and theology the apex, we must now disavow; nor is it that of a circle where the several sections could be evenly joined together or taken apart, or the conception of a linear prolongation as of a tree, or vine, having roots, stem, branches and twigs, a true image. They are merely convenient symbols, but if accepted too strictly, they are apt to mislead. The present classification, like many it has displaced, is provisional and subject to reformation as a whole, as are also the component parts. While mathematics and geometry remain substantially on the bases laid out in the infancy of science, other studies, such as astronomy, geology, physics, chemistry and biology, have been completely recast; nor ought we to suppose that a finality has been reached; indeed, there are signs that portend a reconstruction to bring them all into more harmony. From his psychical, purposive and co-operative nature, man himself must always be entitled to a large and somewhat exclusive space in scientific labors in any scheme of science. Social science has not yet had its methodical reconstruction. Occupied, as it must be, largely with men's wants, motives and passions, it is essentially psychic, and awaits the evolution of the new psychology—just now renascent—before it can claim to be a science of precision and prevision. Meantime, there is much to be done; the very terminology and nomenclature, framed on the old traditional theories, will require to be abandoned or charged with new meaning to fit them to new conceptions.

It begins to look as though the wrong road had been taken in psychology, and that very much of the confusion, clashing and misery of the world is traceable to the error. It does no good, for instance, but harm, to assume as the text books do, or did, that mankind alone exemplifies the social faculty; that he alone is capable of mental development; to deny a mind or soul to the other animals, when they exhibit such human emotions as affection, fear, anger, grief, jealousy, gratitude, avarice, shame, deceit, coquetry, feigning, dreaming—attributes proceeding, so far as they go, on lines parallel to those traversed by all men in the primitive stages and by some men up to this day, but whom, on account of their backwardness, we call savages.

There is, therefore, a human and a subhuman psychology, and (if mere aggregation or association of effort and action is to be accepted as a distinguishing line of division) a subhuman sociology also, so nearly related that continual reference may be made from one to the other, as in the case of comparative anatomy and pathology. For that wide segment of psychic activities peculiar to man, in which there is not merely a consciousness of likeness, of community of burdens and pleasures, but also social purposes, aims and organized

* "The rich have their responsibility here and their duty. Wealth and culture have a special service in their saving influence toward higher standards of thought and life and away from the raging materialism of modern society. And note that the distinction is world wide between luxury and ostentation. That which the rich desire for itself and not as the badge of precedence or the target for silly envy, they may well have—but only on condition that they rather hide than flaunt it. Society is greatly in need of lessons in plain living and high thinking. It is a fallacy to suppose the wastes of the rich are necessary for the employment of the poor. The consumption of the rich determines whether the laborer shall produce this or that, and not whether he shall produce at all. If the rich refrain in some measure from consumption, their savings profit society under the form of capital in the production of a larger social dividend. But the changing demands of vanity stand to society for more than waste and overwork. They corrupt art, they confuse and disturb the organization of industry. First, they corrupt art; no beautiful fashion, if once attained, is safe to stay. If grace and simplicity come as fashions, they go as fashions. The greed of novelty leaves the beautiful behind as antiquated, to be succeeded by the ugliness of hoops and wings. From champagne to plumes of slaughtered birds, from skunk skins to jewelry, there is nothing permanent but novelty, no custom but change. And note that as soon as nothing in art which is good can abide, there will be nothing really good. When the best work can have but a butterfly life, there will be no best work."

"It is at first thought odd that unrest should especially mark the nineteenth century. The world is rich and growing richer, and wise and growing wiser. Never before would a day's labor bring so many dollars or buy so much. . . . A larger, wealthier life is open to us, and it ought to be a greatly happier life. And yet we ask ourselves what does it all profit? Pass rapidly over in thought the question whether with all our centuries of achievement we are so greatly better off than the Greeks without. Is the greater rush and push of life a good thing in itself? What does it mean that the insane asylums yearly build larger for minds unstrung by tension? How about the multiplication of suicides? Likewise our prison populations are not disappearing as the good things of life become cheaper, but theft somehow grows out of plenty.

"There is a grim paradox in civilization somewhere. Wherein do we fail, or waste, or misuse? How is it with all our opportunities? Our harvests somehow do not altogether shield us from hunger or our looms from tatters. What does it mean that as science grows and wealth multiplies, the cry of poverty swells louder and louder, and that discontent is the fatal malady of our civilization? . . . Splendor, no matter how much labor it has cost, is not splendor when it has become general. All may as well stand still as run in an equal race. Thus, material progress, so far as it is directed to competitive show, expends itself in a strife for precedence. There is no share of gain in it for any one which does not stand for discontent and heartache for some one else. All ostentation is waste from the point of view of society as a whole. For the poor it aggravates their poverty."—Davenport: "Outlines of Economic Theory."

or systematic social efforts, in which primitive society is conspicuous (individualism being a later growth), combining plans for security, comfort, enjoyment, aspirations, opinions, creeds, culture, interdependent arts and industries, we have no better name than civilization. That I take to be the cement which binds together individuals in a relation external to that of consanguinity or ethnic derivation. There are archaic types of this culture existing contemporaneously with the modern advanced ones, the strata being curiously intermixed and overlapping barbaric traits cropping out everywhere upon civilization. The most convenient line of separation I can think of between them for the purposes of specialty subdivision is that of literature, the writing faculty being the earmark of the civilized and the lack of it of savage peoples.*

In speaking of the passion for fighting, you will notice I endeavored to account for it as being derived mainly from ancestral experience and as a trait common to man and the lower animals. We make no difficulty about accepting this explanation of those exhibitions of the mind faculty we call instincts; but in regard to the higher faculties, such as reason, will, selfconsciousness and the like, the philosophers have hitherto followed a different but not very satisfactory explanation, and have sought to reserve them to man alone. It is only within the recollection of those now living that any attempt was made to study the mind with the same freedom as any other phenomenon, and to reduce it to an experimental and comparative method; that is to say, for upward of two thousand years the notion of the duality of man had held the field, and any profane meddling with the soul, as the invisible self, ego, or personality, was deemed sacrilege, and would have met with ecclesiastical censure or penalties. The idea that the soul was something more than a function of the organism and appurtenance to it, was per se an entity, lawless, independent, directing, initiating and controlling the bodily movements and capable of maintaining a varying struggle with the passions, emotions, instincts and intellect, was probably derived from Hindostan (although the more consistent doctrine of successive incarnations by the same immortal soul was somehow dropped out in the transit) about the time of Socrates and Plato, and to them and its engrafting on the Jewish mundane religion we may attribute this long fencing off of mental phenomena from scientific observation. The plodding German metaphysics has done much to befog and encourage this cult of separable states of the mind and personality.

There are other traits besides the combative to be traced back to this race experience, such as the awe of the dead, or death bed and burial, the sense of duty or "oughtness," the propensity for lying and stealing, styled "original sin," the feeling of premonitions and of a previous existence, the craving to penetrate the future. Out of these ingrained mind traits metaphysicians have sought to construct "forms of the understanding," "categorical imperative" and innate ideas, dictates of conscience, and from these various systems of philosophy and ethics. Indeed, the claim is still maintained that there are two kinds of truth, the intellectual and the spiritual, and wherever their conclusions differ, the latter is entitled to superior validity. Confusion is thus introduced; and we have the further claim of lifting faith above knowledge, and that religion and its bases have a sphere of their own from which science is excluded. This claim scientists have not taken pains to deny, for science need not hurry, but it concerns them deeply to resent it. While the spiritual theory is defective, I am not disposed to accept the more recent one of the genesis of religious ideas from dreams, ghosts or ancestor worship. These are supporting afterthoughts. The natural wonder as to the first breath of the newly born, the last breath of the dying, the heart throb, ecstasy, suspense of consciousness, decay of mental powers, sportive variations, have helped fasten the notion of a lawless and independent double or shade which, once accepted, has led to all manner of excrescent amplifications.

Underlying this guessing at the mysteries of life, the whence and the whither, the how and the why of it, we may trace alike in man and in brute an impulse of mind or instinct which is phylogenetic, rather than ontogenetic; it belongs to the chain of descent rather than to the last individual links, in which we may discern the germ of all religious emotion. It is analogous with the embryonic progression through lower forms of structure. I mean the inborn propensity of making believe, of personification, and of poetizing in the original signification. This is the true fetishistic basis and bias; it extends to things animate and inanimate, especially if they have some semblance of animate forms. Doll inventing and pet loving are early exhibitions of it, and symbolism in art, image worship and ritualism are later ones. The inherent tendency to apostrophize, to endow or discover life or character, and to reverence is common to savages and to the children of the civilized, and is slowly outgrown by the former; while it lingers in poetry, folk lore and superstitious observances among the latter. Essentially an emotional and feminine trait, it fades with experience and the light of reason; it is probably a vestige of the period when vocal utterance was but feeble and crude and when ideas were conveyed chiefly by signs, mimicry and gesture; the gestures of obeisance, supplication and tenderness being then, as now, very impressive. Such is, I believe, the origin of worship. It has a close analogy in the palimpsestlike reappearance of old and forgotten shadows on the sensitive plate of photography after they were supposed to have been erased and then over-laid with more recent films. Religious ideas had a large use and significance in the infancy of the race and will continually crop out in spite of the culture of later time. In this respect the venerating or worshiping impulse may be likened to the sensation experienced by dramatic recitals, the excitement of the dance or the soothing of rhythmic sounds, the exhilaration of rapid motion; the instinctive clutch of the infant which cannot have experienced a fall; the lingering passion for fishing and hunting; or, to take an extreme illustration, the excited aversion of a kitten at the first sight of a dog or at the first smell of a mouse. By the light we now have we are permitted to offer a physiological explanation of phenomena of mind heretofore quite mysterious. Such puzzling phenomena as hypnosis, fascination, coincident cogitations, double and alternating consciousness, are to be solved in this way.

The time was, not so long ago, when the physiologist would hardly entertain the soul as a subject of speculation, not even in disease, insanity being accounted as possession by devils. The physicist would have thrown it out of his laboratory window, if possible. The labors of anthropologists helped greatly to lead out of that old rut. The study of mind in the multitudes, of the savage, of race traits, of mythologies, folk lore and religious ceremonies betrayed their true origin, and disclosed the likeness of origin and especially the regularity of sequences we call "laws" of thought. The biologists still further broadened the base of psychology by tracing it down through the gradations of organization to the cell, and into plant life; nor is it certain that it stops with life, as we at present define life, but seems to be coextensive with organization.*

Science does not, in one sense, concern itself with teleological suppositions; that is to say, it is reluctant to resort to any of them to explain the observed cosmos, and prefers to listen in a neutral attitude to the rival philosophies—theism, manicheism, atheism, monism, spiritism or materialism; but it is at least equally well equipped to pass judgment on any such speculations as their advocates. The attempt to waive students off from the domain of the soul or from religious beliefs and observances is likely to be disregarded. In fact, the educated ecclesiastic mind now anxiously awaits the verdict of science on the nature of mind, and the origin of some of these innate ideas. When it is found that they are naturally accounted for as belonging to the experience of the race, something not to be ashamed of and still less to be proud of, and are not likely to be superseded very soon, the doctrine will be welcomed as one averting a threatened dissolution. So long as the perpetuity and acceptance of the church dogmas was based upon the inspiration of certain writings, upon miracles, upon special providences, soul peril and soul rescue, or future rewards and punishments, it was exposed to the double risk and cross fire of successful contradiction by science, and by historical criticism, and also liable to the ridicule of scoffers and the charge of outrageous fraud. Science is now on the eve of supplying a broader and more enduring, or at least less precarious, basis for religious ideas than its votaries. When Pope Pio Nono was told that science was undermining some of the foundations of the church, he exhibited a profounder knowledge of human nature and soul nature than the casuists by his reply: "Then we must revive more relics and shrines."

Dr. Andrew D. White has rendered a special service to scientific research and also to ecclesiastical training by his compilation, with abundant citation of textual proof, of the successive awkward retreats from this position of superior spiritual discernment. Whenever the psychologists are ready with the lacking capstone of experimental observable proof as to the act of thought, the further measurements of its velocities, and transformations of matter or motion into that we call consciousness, they will be listened to with profound attention. No propaganda is needed to enforce the conclusions of science, the intelligible statement is enough to overcome the most unscrupulous opposition. What is now waited for is a psychic spectrum to throw as upon a screen the analysis of mental phenomena and to give the equivalent of Fraunhofer's lines in perception, memory, comparison, association, ratiocination, the several emotions below and above the limits of consciousness, and especially to picture for us those puzzling subconscious states the mirages of the will and the self-examination. We may confidently expect (probably from another rash layman) some form of mental bolometer which shall record for us the dimensions and count the number of the vibrations of this hitherto unsuspected mode of motion, if not also to disclose those delicate films which carry some but not others of those external stimuli down to posterity, and fix the stamp of ancient habits, passions and character long after their necessity or utility has vanished. Is it any more wonderful than that the two forces of heredity and environment should preserve the bodily forms and organic structure for a like period? After the publication of Haeckel's famous work demonstrating that man himself in embryo, and often in life, bears the evidence of derivation from, and similarity of nature with, the lower animals, it is not incredible that these mental traits should accompany them for the latter part of the period. As passing from mother to child, we accept them along with the physical features unquestioned. We easily detect them for three or four generations. Why not for ten thousand composite impressions? One is tempted to use the exclamation of Huxley after his first reading of the "Origin of Species:" "Why, how stupid of us that we never thought of that before!"

The retrospect extending so far back enables science to look forward a trifle. The decay of faith, and the crumbling of dogma already giving anxiety to thoughtful men within the ecclesiastical pale, is giving rise to the question: "What is to become of morality when its supernatural sanction is lost?" Prof. Goldwin Smith, from the historian's point of view, naturally apprehends a serious jolt, and doubts whether the present structure of society can stand the transition. The view here taken may reassure the timid. The doctrines which are causing such naïve embarrassment: the fall of man, the atonement, the resurrection of the body, the real presence, anthropomorphic deity and filiation, angels, devils, future rewards and punishments, may fade out and disappear—may, in fact, be relegated to the region of extinct mythologies—but the underlying religious idea, the worshiping instinct, will remain. It is as perennial as the belief in fairy tales, nuptial revels, bereavement, serpent fear, omens, portents, myth making, charms, amulets, lucky stones, and ceremonial superstitions; and having the same ingrained origin. They are vestigial experiences of the race—an inheritance to be outgrown, but meanwhile costly impediments.

RORIG'S LAMP FOR THE DESTRUCTION OF INSECTS.

DESTRUCTION OF INSECTS.

THE problem of the destruction of noxious insects is more difficult of solution than might be supposed. Insecticides are found inadequate, sulphide of carbon, nicotine, emulsion of soap, tar, essential oils, naphthaline, petroleum and sulphate of iron, not to speak of secret compositions, have been recommended. Despite everything, the ravages continuing to increase, the public authorities have occupied themselves with the question. A decree of December 24, 1888, concerning the destruction of insect pests, replaced the old law as to the destruction of caterpillars that was but slightly or not at all enforced. After insecticides, a trial was made of traps and other apparatus designed for capturing moths, flies, butterflies, beetles, etc., by the wholesale. On another hand, M. Finet has devised a permanent evaporator, composed of a glass bottle having a lateral aperture closed by a cork, and which is suspended from the branches of a tree after being filled with a peculiar insecticide. These bottles, to the number of one per square meter, are placed on plantations.

M. Martre invented the tannophore, an apparatus designed to disengage vapors of tobacco juice in greenhouses. But these processes are used locally only. It was but natural to think of utilizing the influence of light and fire upon insects.

M. Gaillot constructed a very popular automatic torch for the destruction of the nests of caterpillars and plant lice. Then a return was made to lanterns, which are sometimes obscured by clouds of phryganids, phalenids and ephemera.

In certain districts it is customary in the evening to light bright fires into which moths and other insects fly and are burned. These curious experiments have been put to profit to effect better work still.

Trunks of trees, boards and vessels have been smeared with honey, molasses and other saccharine substances to which the insects adhere when they come into contact therewith.

In the Journal d'Agriculture of August 20, 1892, we find a description of a trap for the destruction of the cochylis, devised by M. Besnard, of Paris. Two or three of these traps to the acre are sufficient, it seems. The apparatus consists essentially of a lamp surrounded with a conical frame of galvanized iron wire smeared with bird lime, which captures lepidoptera. It is not only moths that can be destroyed in this manner, but also all nocturnal lepidoptera and coleoptera. But, among the new methods that are most apt to give entire satisfaction, we believe that one of the best and most practical is the apparatus invented not long ago by Dr. Rorig.

The following is a brief description of this apparatus, which we illustrate herewith:

A lamp is inclosed in a hexagonal lantern, every side of which contains an aperture which is provided with a strong lens preceded by a conical reflector through which insects, attracted by the light, can enter. At its upper part the lamp is formed of a pyramidal cover provided with ventilators that allow of the exit of the hot air, but preventing the escape of the insects. It is closed at the bottom by a pyramidal base that leads to a reservoir into which is put a saccharine and odoriferous mixture that attracts the insects. The latter, after entering the lantern, are unable to make their exit therefrom and slide into the lower receptacle, which it suffices to empty from time to time. The diameter of the lantern is 0·31 m.; the sides are 0·15 m. square, and the diameter of the front aperture is 0·13 m. The instrument is placed in a tree or in the open field.

The expense of keeping the apparatus in working order is very small. The present price of the lamp, however, is too high to allow the use of it to become

* If the present classification is to stand, anthropology covers all human affairs and thoughts—a field too vast for a single cultist to master in all its detail. Ethnology, archæology, somatology and spoken languages would seem to belong to it somewhat exclusively. How, then, are the remaining human activities to be divided, such as civics, politics, demography (vital statistics), economics, ethics, esthetics, arts, industries, education, creeds, opinions, folklore, linguistics? Dr. McGee, in a very commendable scheme of anthropology, has used the word sophiology as a generic title for the more psychic of these, which seems to me to be a more scientific and more natural line of cleavage (and one which will appeal to the sense of responsibility of the council) than sociology—a hybrid at best, which not even the brilliant sponsorship of Comte, Spencer, Giddings, Small and others in professorial chairs can reconcile with other sciences. Any arbitrary line of separation is attended with difficulty; but if these studies could be divided into two or three departments, it would tend to reflect the present trend of research.

* For opinions on the coextensiveness of mind with life and organism see Haeckel's "Creed," E. D. Cope's "Primary Factors of Evolution" (concluding chapter), Darwin's letters, Clodd's "Pioneers of Evolution," Romanes and others, Neo-Lamarckians and Neo-Darwinians.

For expressions on the pervading reach of mind, as exhibited in unorganized matter—as a property of matter—in the curious behavior of substances like camphor grains, gamboge, frost crystals on plate glass, figures on vibrating membrane, see current literature of physics and chemistry, Prof. A. E. Dolbear's "Matter, Ether and Motion," also the concluding sentences of his lecture at Wood's Holl Biological Station: "At any rate it is evident that if any such theory of matter as is here presented be true, and if the behavior of matter as we see it in the test tube and microscope has been interpreted with any approach to the truth, then it is a much more wonderful thing than the old philosophers thought; its possibilities greatly exceed what could before have been imagined; and if mind itself requires a material habitat, then it has in an atom an imperishable living home."

common. It would be easy to simplify it by adopting a less costly arrangement, and farmers might then use it with great profit.—La Nature.

THE PUNIC NECROPOLIS OF DOUIMES, CARTHAGE.

TOWARD the end of the summer of 1893, the Rev. Father Delattre began a series of excavations at Douimes, Carthage, which resulted in the discovery of an interesting and extensive necropolis. By the month of November of that year he had opened upward of sixty tombs. One of these, discovered on November 28, was

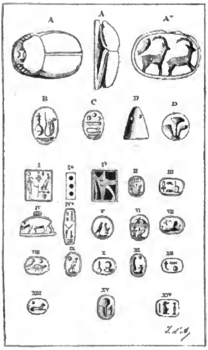


FIG. 1.—CARTHAGINIAN SCARABÆUS AND AMULETS.

double, and constructed of beautiful slabs of tufa, the only kind of stone employed in the primitive Carthaginian structures. Each compartment was 2·05 m. in length, 0·75 m. in width and 1·10 m. in height. The two mortuary receptacles were put in communication by an aperture in the median partition. In one of the compartments there were found, in addition to the usual objects (double urn, amphora, lamp and patera), alongside of the skeleton, two nearly hemispherical vessels with a conical appendage upon the belly, a ring, and a scarabæus bearing three hieroglyphic characters reading: "RA is the true ichneumon"—an allusion to the worship of the ichneumon and to its identification with RA. The Egyptians, in fact, worshiped the ichneumon or Pharaoh's rat (Herpestes pharaonis).

The scarabæus in question is reproduced in No. VIII of the accompanying Fig. 1. The following is, according to M. Maspero, an explanation of the pieces reproduced in this figure: B and C are scarabæi carrying a device that had no meaning except to the possessor.

FIG. 2. SCARABÆI

D and D' represent a cone worn as an amulet. At its base is seen a tuft of lotus.

The rectangular tablet that carries the first number is of a whitish material and provided with three apertures. One of its faces shows the "oudja" or eye of Osiris, and the other bears a scene of Egyptian mythology thus interpreted by M. Maspero:

The goddess Sokhit, crowned with the disk, a scepter in her hand. Her name is written in front of her. In front, the banner name "Horou âa hiti," the magnanimous Horus of Pharaoh Psammetichus of the XXVIth dynasty.

M. Maspero remarks that this very delicately executed amulet certainly gives the highest limit to which we can carry the age of the tomb in which the object was found.

Psammetichus, who founded the twenty-sixth dynasty, was one of the twelve kings who divided the government of Egypt between themselves after the death of Pharaoh Sethos, whom a statue represented, rat in hand, with this inscription: "Learn by my example to respect the gods." It was doubtless the ichneumon that Sethos thus presented for the veneration of the Egyptians. Psammetichus reigned from 671 to 656 B. C. over the northwest part of Egypt, to the east of the Delta. He succeeded in driving out his colleagues, and afterward reigned alone until the year 617. It is related of him that he built temples at Memphis in honor of the bull Apis and of Phtah. This Pharaoh called foreigners to Egypt, had a navy organized and tried to conquer Phenicia.

These details show on the one hand that the tomb that contained the amulet above described cannot date back further than the seventh century before the Christian era. This, moreover, will establish the date of the most ancient objects found in the necropolis.

Scarabæus No. II. Upon the corbel is seen the

FIG. 3.—GOLD EARRING AND NECKLACE BEAD.

cartouche of Menkaouri (Mycerinus, the Mycerinus of Herodotus and the Mencheris of Manetho), the founder of the third of the great pyramids of Gizeh. Above is the title, "Horou noubi," the Gilded Horus, the Victorious Horus and the goddess Sokhit with the lioness' head, in the same posture as in the preceding number.

The style, says M. Maspero, indicates the "saite" epoch. The name Menkaouri, like that of Thoutmosis III (Mankhopirri) or of Amenothes III (Nibmaouri), was reproduced at all epochs by way of an amulet, on account of the mystic sense that it possessed.

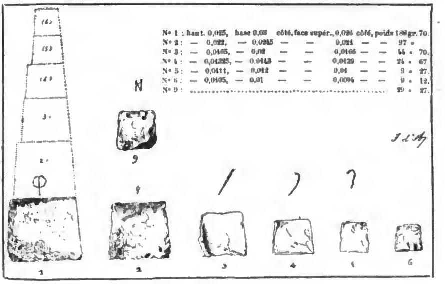
No. III. Isis Onkhit, "the living one," a female proper name or one dedicated to the goddess Isis, whose name would be followed by the frequent epithet "onkhit," the living one.

No. IV. Amulet in the form of a sow or hippopotamus. Upon the plate is read: "Phtah, good messenger who protects the entire earth (Egypt)."

No. V. The god with hawk's head, and the hawk of RA upon the corbel.

No. VI. Har-Khobi, Horus of Bouto, upon the corbel. M. Maspero seems to think that the winged disk transformed into a bird proves the Phenician origin of the object.

No. VII. Sphinx. The characters above may be Phenician. They have not been deciphered.



Nº 1 :	haut. 0,025,	base 0,03	côté, face supér.,	0,026	côté,	poids	1?? gr.	70.
Nº 2 :	— 0,022,	— 0,0245	—	— 0,021	—	—	97 »	
Nº 3 :	— 0,0165,	— 0,02	—	— 0,0166	—	—	55 »	70.
Nº 4 :	— 0,01325,	— 0,0143	—	— 0,0129	—	—	24 »	67.
Nº 5 :	— 0,0111,	— 0,012	—	— 0,01	—	—	9 »	27.
Nº 6 :	— 0,0105,	— 0,01	—	— 0,0096	—	—	9 »	12.
Nº 9 :	....						29 »	27.

FIG. 4.—CARTHAGINIAN LEAD WEIGHTS.

No. VIII. This is the scarabæus already spoken of. We read here: "RA is the true ichneumon."

No. IX. RA and Horus upon the corbel, a formula having no signification except to the owner.

No. X. "RA is the good master."

No. XI. Nebmâiri, "a master of the truth is RA."

No. XII. Name of the moon god Thebain, son of Amon and Mout.

No. XIII. RA or the sun god and a lion.

No. XIV. The cynocephalus Thot, whose voice enchants by its magic power.

No. XV. The disk of the sun surmounted by two feathers.

The description and sense of these few scarabæi show the relation that existed between Egypt and Carthage from the view point of customs, religion and commerce.

The excavations were continued at intervals between December 29, 1893, and January 31, 1894, and besides the usual objects, there were discovered some Greek vases, some unguentaria of glass and alabaster, some ostrich eggs, some copper and bronze mirrors, some earrings (Fig. 3), some amulets, and, finally, two bronze scale pans and a series of lead weights. These weights (Fig.

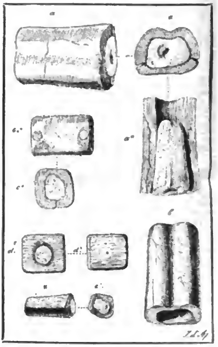


FIG. 5.—CARTHAGINIAN BONE WEIGHTS WITH THE ADJUNCTION OF LEAD.

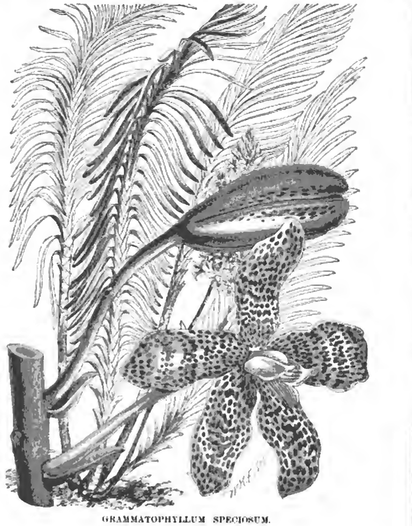
4), which were nine in number, were all truncated pyramids in form, and of square section. Six of them were marked with a peculiar sign. The following were their respective values in grammes: 196·8, 96·7, 44·6, 24·6, 11·18 and 9·12.

The first set of weights found in the Douimes tombs was of lithographic stone of a greenish color and smooth and soft to the touch. It consisted of six weights. The largest of these was rectangular in form and weighed 89·8 grammes. The others were of the form of a truncated pyramid, with the exception of a round flint stone, which appeared to have replaced one of the weights wanting in the set. The respective values of the weights, in grammes, were 45·45, 23, 11, 42, 4·65 and 25. The smallest weight was marked with the Punic letter eh. The signs that the others bore were not alphabetic characters.

Another set was of bone with the adjunction of lead (Fig 5). In view of the material, the value of these weights could not necessarily be as exact as that of the metal or stone ones. The following are the respective values of them in grammes: 99, 35·2, 19·8, 12·5, 8·4 and 3·15. For the above particulars and the accompanying engravings we are indebted to Cosmos.

GRAMMATOPHYLLUM SPECIOSUM.

THE event of the week, horticulturally considered, has been the exhibition of a noble spike of this orchid by Sir Trevor Lawrence. An idea of it can be gleaned from our figure, repeated from a former volume. At the bottom of the spike in Sir Trevor Lawrence's plant were two abnormal flowers, one of which is figured in our engraving. This flower had four nearly equal segments in two rows—no true lip and a straight column—a very common state of things among orchids, and interesting as showing the probable derivation of the ordinary irregular orchid flower from a regular type. The plant is recorded to have flowered first in 1851 in Loddiges' nursery at Hackney, while a much finer specimen appeared in 1859 in the garden of W. G. Farmer, Esq., Nonsuch Park, Ewell, and subsequently another was flowered by Mr. Scott, gr. to Sir G. Staunton, Leigh Park. Mr. Curtis, of Penang, a few years since sent us a photograph of a magnificent plant of this species of dimensions that we hesitate to cite. Unfortunately, the photograph was unsuitable for reproduction. Another fine but much smaller specimen was imported by Messrs. Sander & Company, of St. Albans. We gave a figure of the extraordinary snakelike pseudo-bulbs denuded of leaves, and with its curious ascending roots, at the back page of the index for vol. xiii, 1893. This specimen was presented to the Royal



GRAMMATOPHYLLUM SPECIOSUM.

Spike 7 feet high; flowers 5 inches across.

Gardens, Kew, by Messrs. Sander, and forms now one of the most striking objects in the Victoria house. The roots have access to the water, and the plant is in vigorous health, and will no doubt flower in another season. The plant is a native of Java and other islands of the Indian Archipelago. The prevailing color of the flower is dull yellow, thickly dotted with reddish purple spots. The pseudo-bulbs attain a height of 9 to 10 feet, and the flower scape measures 6 feet and upward in height. The flowers measure 5 to 6 inches across.—The Gardeners' Chronicle.

[Continued from SUPPLEMENT, No. 1134, page 18132.]

THE SPREAD OF LAND SPECIES BY THE AGENCY OF MAN; WITH ESPECIAL REFERENCE TO INSECTS.*

By LELAND O. HOWARD, Ph.D.

IN considering the question as to the regions with which an interchange of forms is most likely to occur, it is obvious that they are those which have the greatest similarity of climate, and, most nearly, identity in point of time of seasons; those, in fact, which are most likely to afford similar environmental conditions. A study of the similarity of faunas and floras already existing will lead us to the same result. Wallace has pointed out that with the Coleoptera the best marked affinities between regions are those between the Nearctic and the Palaearctic, the Oriental and Australian, the Australian and the Neotropical, all of which appear to be about equal in each case. Next comes that between the Ethiopian and the Australian on the one hand and the Ethiopian and the Neotropical on the other, which also appear about equal. Then follows that between the Nearctic and Neotropical regions, and lastly, and by far the least marked, that between the north temperate and south temperate regions.

Further, in the consideration of accidental commercial importations, the amount and frequency of commercial interchange and the rapidity of the journey are most important factors.

From all of these considerations combined we arrive at the conclusion that the regions with which accidental interchange of species should be most frequent are Europe and North America, and this is with insects to a certain extent borne out by the facts. The introduction of species from Europe into North America is of everyday occurrence and their establishment is far from rare. The carriage of American species to Europe is an equally frequent matter, but their establishment is much less frequent.

I have studied in this connection—my profession being that of an economic entomologist—principally the species which are prominent as injurious to horticulture or agriculture or in other ways inimical to man. Listing the insects of prime economic importance in the United States, the species each of which almost annually causes a loss of hundreds of thousands of dollars, we find that they number seventy-three. Of these thirty are native, while thirty-seven species have been introduced, six species being of doubtful origin. Of the thirty-seven introduced species, thirty have come to us from Europe, all, with one exception, as accidental importations.

Of the prominent European injurious insects, on the other hand, but three are said to have come from America; the grapevine phylloxera (Phylloxera vastatrix), the woolly root louse of the apple "American blight" (Schizoneura lanigera), and the Mediterranean flour moth (Ephestia kuhniella). Of these but one is certainly American—the phylloxera. The origin of the Schizoneura is somewhat doubtful, while the Mediterranean flour moth is not American, but probably came to us from Europe, although originally it is probably Oriental

As with these insects of prime economic importance, so it is with other less noted species. There have been rather frequent establishments of European species in America, but practically none of American species in Europe. The reason for this curious condition of affairs is difficult to find. The general trend of accidental importations seems to have been westward, and it is doubtless a fact that certain of our now cosmopolitan forms were originally Asiatic and have traveled westward, through Europe, to and across America, and thence to Hawaii, New Zealand and Australia. The existence of such a law is borne out in the study of plants as well. The statement just made regarding insects of prime economic importance is almost exactly paralleled with the plants classed as weeds. It has thus been shown that, out of two hundred American weeds, one hundred and three are introduced, of which ninety-six are from Palearctic regions, sixty-eight being native to Europe, while it seems that less than half a dozen American species have become troublesome in Europe. A number of American species, however, have been carried to Australia and flourish there with vigor.

This general trend from east to west has always been in the direction of the newer civilization—from the older civilization to the newer. That this in itself is significant cannot be doubted, and in the case of the insect and plant enemies of agriculture the facts surrounding this condition are almost in themselves sufficient to account for this direction movement. I have shown in another paper that the denser population of the older countries and the resulting vastly smaller holdings in farms, the necessarily greatly diversified crops, the frequent rotations of crops, together with the clean and close cultivation necessitated by the small size of the holdings, and the cheaper and more abundant labor, will all operate as a barrier against the establishment of injurious species, while the reversed conditions in a newer country at once liberate an introduced species from the repressive conditions which affected it in its original home and encourage its establishment, multiplication and spread. But there are deeper causes than this at work. It has been suggested that the flora and fauna of America, the older continent, have become degenerate through age and cannot successfully resist competition with the more vigorous forms introduced from the younger continent of Europe,* and that there are not yet formulated climatic differences favorable to the development of Palearctic forms on the American continent; but these theories seem unsusceptible of proof, and for the present we must content ourselves to accept the facts as we find them.

The insects which are accidentally imported are carried in three main ways. Either (1) they are unnoticed or ignored passengers on or in their natural food, which is itself a subject of importation, such as nursery stock, plants, fresh or dried fruit, dried food stuffs, cloths, lumber or domestic animals; or (2) their food being the packing substances used to surround merchandise or the wood from which cases are made, they are thus brought over; or (3) they may be still more accidental passengers, having entered a vessel being loaded during the summer season, and hidden themselves away in some crevice. The coleopterists (Hamilton and Fauvel) make a distinction by name among these classes, calling the first group "insects of commerce" and the latter "accidental importations."

It would appear on the face that these more strictly accidental importations must be rarer than those which are termed commercial importations, yet of the 156 introduced Coleoptera recorded by Dr. Hamilton in 1889, sixty only were considered by that writer as insects of commerce, while 96 he thought had been brought over in this accidental way.

The remaining Coleoptera common to North America and the Palearctic region, 278 in all, Dr. Hamilton considers to be practically circumpolar species, or at least not imported. Fauvel in his remarks and additions to Hamilton's catalogue raises the number of non-introduced or circumpolar species to 306, leaving 125 as imported, of which only 28 appear to have been imported from temperate Europe, the rest being cosmopolites or subcosmopolites. Of the latter class he thinks that 50 originally came from the temperate Europeo-Siberian fauna, 10 from the Oriental fauna, 15 from the Ethiopian, 4 from the Neotropical, 7 being uncertain and 2 unknown.†

It should be noted, however, that there is grave room for difference of opinion regarding a number of the European species considered by him as indigenous to North America. Scolytus rugulosus, Hylastinus trifolii, Anthrenus scrophulariæ, Sitones hispidulus, Cryptorhynchus lapathi, and a number of others which might be specified for example, have undoubtedly been imported from Europe and were quite possibly originally imported.

There are obstacles in the way of the establishment and spread of species which are imported quite by accident which usually do not exist in the case of the so-called commercial importations. In many cases, entering the vessel by accident, they exist there as single individuals, and upon liberation, even should the conditions be favorable, only gravid females could perpetuate the species. Then also the majority of such specimens are liberated upon the unloading of the vessel upon the wharves. The water front of a seaport city is not a favorable place for the establishment of a species which feeds on living vegetation. Frequently, even when it is a species well fitted for acclimatization, it will have to fly or be carried for miles inland before it can find a place possible for the establishment of the species. So it happens that while foreign insects are frequently found in living condition about the wharves of our larger seaports during the summer months, almost none have succeeded in getting a foothold in the vicinity. Mr. Otto Lugger, when living in Baltimore, Md., made a collection of many species of foreign insects found upon the wharves, yet he has recorded the establishment of but a single species, viz., Aphodius erraticus, a European dung beetle, which managed to get to Druid Hill Park, where it bred in the dung of the tame deer, afterward spreading into the surrounding country and breeding in the dung of sheep and other domestic animals.

Practically, therefore, after many years of the most active commerce, the insect faunas of the immediate vicinity of the larger seaports, like New York, Boston, Philadelphia and Baltimore, have not been greatly changed by the introduction of foreign elements.

All of the household insects and true city insects are, of course, exceptions to this conclusion, and the strong flying, vigorous, and simple living dipterous insects—

* Paper read before the Zoological Section of the American Association for the Advancement of Science, August, 1897. A portrait of Doctor Howard will be found in the SCIENTIFIC AMERICAN of September 25, page 196.

* The spread of European species in Australia has been explained by the superior energy of the younger races of the Palearctic region.

† Hamilton, in his 1894 paper, raises the number of Coleoptera common to the two countries to 394, making the number of introduced species 216.

the very ones most likely to enter a loading vessel and to escape on the discharge of its cargo—will many of them find proper places for breeding. It is likely that a much larger proportion of the many species of Diptera common to Europe and North America have been brought over in this accidental manner than is the case with the Coleoptera.

But often these purely accidental species are carried inland in packing cases, into the cracks of which they may have crawled, or even in the trunks of passengers, and they may then be liberated in more favorable localities. For example, Mrs. H. G. Hubbard, after spending the summer on Prince Edward's Island, returned in the autumn to Detroit, Mich., and in unpacking her trunks her husband found two specimens of Phytonomus punctatus, a species not previously known to occur in Michigan, although found there in injurious numbers a year or so later. It is altogether likely that the imported elm leaf beetle (Galerucella luteola), an insect which enters houses for hibernating purposes, was first brought to America in this manner.

It is, however, the accidental commercial importations which theoretically stand the best chance of establishing themselves, since, in the first place, they are generally imported in or upon their natural food. In the second place, they generally occur in considerable numbers, instead of as isolated individuals, as with the more purely accidental importations; and, in the third place, they are usually carried as originally packed, far from the port of entry.

With insects brought over on plants or nursery stock the conditions could not well be much more favorable. Their supply of food is looked after with care, the host plant is soon put in the ground under the best of surroundings, and the greatest care is taken of the choice importation. Upon or in importations of this kind are carried Coccidæ in all stages of growth, and often, fortunately, their inclosed parasites, the eggs of Aphididæ, the larvæ of wood boring Coleoptera, the eggs of many other insects, the cocoons of small Lepidoptera, and probably even in rare cases the larvæ of Lepidoptera, since it now seems likely that Euproctis chrysorrhœa was imported into Massachusetts on nursery stock in its larval hibernacula. The Coccidæ, however, are most abundantly carried in this way. Under natural conditions these insects have usually a rather restricted distribution, but by means of this commercial distribution many of them have become of almost world-wide range, and the end will certainly not be reached until every country possesses every species of scale insect which can possibly live in its climate. A few instances drawn from a recent paper by Mr. Cockerell will illustrate this fact:

Diaspis amygdali, or lanatus, was described from Australia in 1889. To-day we know it from Australia, Ceylon, Hong-Kong, Japan, several localities in the United States, Jamaica, San Domingo, Grand Cayman, Barbados, Martinique, Trinidad, and Cape Colony.

Aulacaspis rosæ was described from Europe, but is now found also in the United States, Australia, New Zealand, the Sandwich Islands, China and Jamaica.

Chionaspis citri was described from Louisiana and Cuba in 1883 and is now known from Trinidad, Antigua, Demerara, Bermuda, Mexico, Tonga, New Zealand and Australia.

Howardia biclavis was described in 1883 from specimens on hothouse plants in Washington, D. C. Now it is known out of doors from Trinidad, Mexico, Tahiti, Sandwich Islands and Ceylon.

Lecanium oleæ is found in Europe, the United States, the West Indies, Mexico, Sandwich Islands, New Zealand, Australia and Cape Colony.

The hymenopterous parasites of the Coccidæ by virtue of their mode of life, have spread almost equally with their hosts by means of this commercial transportation. I have been able to show recently that by this means a number of species of the Chalcidid subfamilies Aphelininæ and Encyrtinæ have, in comparatively recent years, become cosmopolites. For example:

Aspidiotiphagus citrinus, originally described from California in 1891, is now found in many other portions of the United States, in the West Indies, Italy, Austria, Ceylon, China, Formosa, Japan, Cape Colony, Queensland, South Australia and Hawaii. Practically the same remarkable distribution is followed by Prospalta aurantii, Aphelinus mytilaspidis, A. diaspidis and A. fuscipennis, while the remarkable and system-breaking Encyrtine, Arrhenophagus chionaspidis, described by Aurivillius from Swedish specimens in 1888, has since been found in Austria, Italy, several portions of the United States, Ceylon, Japan, Formosa, and China.

Only second to the Coccidæ in the facility with which they are transported in this way are the Aphididæ. These insects, however, are fragile, soft bodied and unprotected. They are readily carried, however, in the winter egg condition, and many species are rapidly becoming cosmopolitan. They have not been studied, however, elsewhere than in Europe and the United States, and the extent to which this commercial distribution has been carried can only be surmised. A suggestion of this extent, however, occurred to me when within the past few weeks specimens of Aphelinus mali, a common parasite of Aphididæ in Europe and North America, were received from such a comparatively out-of-the-way corner of the world as Passaruan, Java.

Other still smaller and still less studied insects are undoubtedly carried by this method of transportation, as the recently discovered identity of certain North American Thysanoptera with those of Sweden and Russia would seem to show. The small plant-feeding mites of the family Phytoptidæ are particularly subject to this form of commercial distribution, and when they are fully studied, it will doubtless be found that many forms have become subcosmopolitan.

Of larger insects, nearly all of the wood-boring beetles common to Europe and the United States have probably been brought over in this way, Zeuzera pyrina, the large wood-boring cossid moth, also probably came over on living plants; and, as I have just stated, the newly imported brown tail moth, Euproctis chrysorrhœa, was probably at Boston with nursery stock.

Careful observations on the insects transported with this class of merchandise have never been made, except possibly at the port of San Francisco. At this port the State Board of Horticulture has established under State laws a quarantine for all incoming plants and fruit. The entomologist and quarantine officer, Mr. Alexander Craw, has entire jurisdiction over such articles consigned to points within the State, and examines, destroys and fumigates at his discretion. He has not, however, in his reports given us complete lists of the insects collected in this work, although I understand from persons who have visited his office that he has preserved collections of the more important species from an economic standpoint. The vessels examined have, almost without exception, come from Pacific ports, and the difficulty of naming insect material thus received would be very great. It is this fact which has probably hitherto prevented the publication of a general list. A list of the scale insects, however, has been published.*

Between July 2, 1894, and August 29, 1896, Mr. Craw inspected 232 vessels carrying plants or other articles liable to be infested with living insects and consigned to California individuals or firms. One hundred and twenty-two lots he found clean and passed; 40 lots he admitted after fumigation; 20 lots he destroyed and 78 lots he destroyed in part. One lot, consisting of 1,000 boxes of apples, he sent back on the refusal of the owner to allow them to be fumigated.

Living plants and nursery stock afford, then, perhaps, the most certain means for the accidental transmission and subsequent establishment of many kinds of insects. Commerce in objects of this class is rapidly increasing, and has already assumed considerable proportions, the imports into the United States alone in the fiscal year ending June 30, 1896, having reached a value of nearly $1,000,000, while the previous year they amounted to something over $900,000.

No great elaboration will be needed concerning the importation of foreign insects upon fruits, fresh and dry, other dry food stuffs, cloths, lumber or domestic animals. Fruits were imported into the United States in the fiscal year 1895-96 to the value of nearly $20,000,000, and, unquestionably, upon imported fruits are carried many insects. The opportunities for the establishment of species coming with fresh fruit, however, are obviously slight as compared with those which come on living plants or in dried foodstuffs, and, as a matter of fact, it appears that already nearly all of the dried food insects have become cosmopolitan. The same may be said of the insects which affect domestic animals. The forms which are truly parasitic in the larval stage have most of them been carried everywhere, while the other forms which attack domestic animals only as adults have some of them been carried far and wide. As an example, we may recall the European Hæmatobia serrata, which was brought to New Jersey probably in 1885, and which has spread over the entire country from Maine to California.

The fact that insects may be, and doubtless are, transmitted in the material used in packing heavy or delicate merchandise must not be overlooked. We have already shown that dangerous weeds have been transmitted in this way, and when the material is hay or straw the danger of importing certain injurious insects becomes great. Cecidomyia destructor, the well known Hessian fly, is supposed to have first been brought to the United States from Europe in straw bedding on troop vessels during the war of the revolution, and to have recently been carried from Europe to New Zealand in the straw packing of merchandise. Laws recently proposed in New Zealand, Australia and Cape Colony provide that such straw or hay packing shall be burned immediately the case is opened. Dr. H. Loew, in his well known paper, "Ueber die Dipteren-fauna des Bernsteins," has shown that several of the species of the genera Oscinis and Chlorops have gained a wide distribution through commerce, and this probably happened through their occurrence in hay or straw used as packing, since they live in the stems of grains and grasses. Dr. Loew, by the way, considered the Diptera, by virtue of the simple conditions required for their existence, to be peculiarly susceptible to commercial and accidental distribution, and was inclined to believe that the majority of the many species common to Europe and North America have been imported into the latter country. He understood, however, the existence of a circumpolar fauna, and wrote wisely and learnedly about the common ancestry of what he called analogous species. Whatever may be the cause, the Diptera seem fitted in the individual to withstand widely differing environmental conditions. The group as a whole has apparently little faunistic value either along broad lines or in a more restricted way. There are comparatively fewer characteristic genera in the main faunal regions of the world than in other groups of animals, and in our own country there are comparatively few species of restricted distribution. Very many individual species range through the Lower and Upper Austral, through the Transition and into the Boreal regions.

Aside from the Diptera, grains and grasses all over the world are subject to the attacks of a host of insects of all kinds, many of which hibernate on or within the stems, so that the proposed legal provisions of the English colonies mentioned are by no means unwise. The substitution of the wood material known as "excelsior," the use of which is becoming so common in this country, or of some other packing material, will shortly do away with a large share of this danger.

There are, of course, other less important methods by which insects may be transported, such as in earth or damp moss about the roots of plants and in sand used for ballast. These methods, however, are not very important as a rule, although it is stated that the destructive chigoe (Sarcopsylla penetrans) was carried in ballast in 1872 on a vessel from Rio Janeiro to the coast of Guinea, where it has established itself most perfectly, having been found two hundred miles inland by Stanley.†

(To be continued.)

* Bull. 4, Tech. Ser. Div. Entom. U. S. Dept. Agric., 1896, pp. 40, 41.

† Die Umschau, July 17, 1897, p. 523.

Aluminum is now used in making clock hands, for which it is an ideal material. The pointers of great clocks were formerly made of soft wood. For these were substituted pointers made of thin sheets of copper, a pointer being composed of two strips, which were cupped or hollowed, and then brought together edge to edge, with the rounded sides out, thus giving rigidity as well as lightness. Aluminum pointers for big clocks are made in this way, but they are far lighter and easier to balance. It is not unusual on large clocks in windows and elsewhere to see projecting from the base of the long pointer and in line with it a rod with a ball at the end, this rod being perhaps a third as long as the big pointer. This rod and ball are a counterweight for the big pointer, which, without a counterweight, would, in its movement around the dial, wear unevenly upon the arbor or shaft which carries it. On great clocks, and often on big clocks indoors, this counterpoise is placed inside the dial, out of sight, on the arbor. The heavier the pointer, the greater the weight required in the counterpoise; the greater the weight, the more friction on the arbor; and the more friction, the greater power required to drive the clock. By the use of aluminum pointers these drawbacks are reduced to a minimum.

THE BRITISH ASSOCIATION—ADDRESS IN ANTHROPOLOGY.

The address in Section H was delivered by Prof. Sir W. Turner, D.Sc., F.R.S. L. and E., who selected as the subject:

Some Distinctive Characters of Human Structure.

When we look at man and contrast his form and appearance with other vertebrate creatures, the first thing probably to strike us is his capability of assuming an attitude which we distinguish by the distinctive term "erect." In this position the head is balanced on the summit of the spine, the lower limbs are elongated into two columns of support for standing on two feet, or for walking, so that man's body is perpendicular to the surface on which he stands or moves, and his mode of progressing is bipedal. As a consequence of this, two of his limbs—the arms—are liberated from locomotor functions; they acquire great freedom and range of movement at the shoulder joint, as well as considerable movement at the elbow and between the two bones of the forearm; the hands also are modified to serve as organs of prehension, which minister to the purposes of his higher intelligence. The erect position constitutes a striking contrast to the attitude assumed by fish, amphibia, and reptiles when at rest or moving, in which vertebrates the body is horizontal, and more or less parallel to the surface on which they move. Birds, although far removed from the erect attitude, yet show a closer approximation to it than the lower vertebrates or even the quadrupedal mammals. But of all vertebrates, those which most nearly approximate to man in the position assumed by the body when standing and walking are the higher apes. The various adaptations of structure in the trunk, limbs, head, and brain which conduce to give man this characteristic attitude are essential parts of his bodily organization, and constitute the structural test which one employs in answering the question whether a particular organism is, or is not, human. These adaptations of parts are not mere random arrangements, made at haphazard and without a common purpose; but are correlated and harmonized so as to produce a being capable of taking a distinctive position in the universe, superior to that which any other organism can possibly assume. If we could imagine a fish, a reptile, or a quadruped to be provided with as highly developed a brain as man possesses, the horizontal attitude of these animals would effectually impede its full and proper use, so that it would be of but little advantage to them. It is essential, therefore, for the discharge of the higher faculties of man, that the human brain should be conjoined with the erect attitude of the body. The passage of a vertebrate organism from the horizontal position, say of a fish, in which the back, with its contained spinal column, is uppermost, and the head is in front, to the vertical or erect position of a man, in which the back, with its contained spinal column, is behind, and the head is uppermost, may be taken as expressing the full range and limit of evolution, so far as the attitude is concerned, of which such an organism is capable. Any further revolution of the body, as in the backward direction, would throw the back downward, the head backward, and would constitute a degradation. It would not be an advance in the adaptation of structure to the duties to be discharged, but rather an approach to the relation of parts existing so generally in invertebrate organisms.

ANATOMY OF MAN AND THE LOWER ANIMALS.

By the publication in 1859 of Darwin's ever-memorable treatise "On the Origin of Species by Means of Natural Selection," an enormous impulse was given to the study of the anatomy of man in comparison with the lower animals, more especially with the apes. By many anatomists the study was pursued with the view of pointing out the resemblances in structure between men and apes; by a more limited number to show wherein they did not correspond. I well remember a course of lectures on the comparative characters of man delivered 35 years ago by my old master, Prof. John Goodsir, in which, when speaking of the hand of man and apes, he dwelt upon sundry features of difference between them. The human hand, he said, is the only one which possesses a thumb capable of a free and complete movement of opposition. It may be hollowed into a cup and it can grasp a sphere. It is an instrument of manipulation co-extensive with human activity. The ape's hand is an imperfect hand, with a short and feeble thumb, and with other clearly defined points of difference and inferiority to that of man. It can embrace a cylinder as the branch of a tree, and is principally subservient to the arboreal habits of the animal. Its fingers grasp the cylinder in a series of spirals. Here, then, is an important difference in the manipulative arrangements of the two hands, the advantage being with the hand of man, in regard to the greater variety of movement and adaptability, to co-ordinate it with his reasoning faculties. As showing the acuteness of perception of Goodsir and his complete recognition of a fundamental feature of the human hand, he also dwells on the hand being able to form a circle around a sphere, so as to grasp it on every side, and to touch it with every part of itself, while it can also securely hold objects that possess plane or concave surfaces. If we compare the new born infant with the young of vertebrates generally, we find a striking difference in its capability of immediately assuming the characteristic attitude of the species. A fish takes its natural posture and moves freely in its element as soon as it is hatched. A chicken can stand and walk when it is liberated from the egg, though, from its

wings not being developed, it is not at once able to fly. A lamb or calf can assume the quadrupedal position in a few minutes after birth. But, as we all know, the infant is the most helpless of all young vertebrates, and is months before it can stand on two feet and move freely on them. During the period of transition, from the stage of absolute dependence on others to the acquisition of the power of bipedal progression, important modifications in the structural arrangements both of the spine and lower limbs have to take place. At the time of birth the infant's spinal column exhibits only two curves; one, corresponding to the true vertebræ, extends from the upper end of the neck to the lowest lumbar vertebra, and the concavity of its curve is directed forward; the other and shorter corresponds to the sacro-coccygeal region, and also has its concavity directed forward. In the number and character of the curves, the new-born infant differs materially from the adult man, in whose spine, instead of one continuous curve from the neck to the sacrum, there are alternating curves, one convex forward in the region of the neck, succeeded by one concave forward in the region of the chest vertebræ, which again is succeeded by a marked convexity forward in the vertebræ of the loins. The sacro-coccygeal region continues to retain the forward concavity of the new-born child. The formation and preservation of this alternating series of curves is associated with the assumption of the erect attitude, and the development of the lumbar convexity is correlated with the straightening of the lower limbs when the child begins to walk.

THE ERECT ATTITUDE.

It has sometimes been assumed that the acquisition of the erect attitude by the young child is due to the fostering care of the mother or nurse; that it is a matter of training, encouragement, and education, without which the child would not raise itself upon its feet. I cannot, however, agree with this opinion. If one could conceive an infant so circumstanced that, though duly provided with food fitted for its nutrition and growth, it should never receive any aid or instruction in its mode of progression, there can, I think, be little doubt that when it had gained sufficient strength it would of itself acquire the erect attitude. The greater growth in length of the lower limbs, as compared with the upper, would render it inconvenient to retain the creeping or the quadrupedal position. We cannot lose sight of the important influence which, altogether independent of education, is exercised by parents on their offspring. The transmission of hereditary qualities, through the germ from which each individual organism is derived, is one of the fundamental and most striking properties of the germ plasm. Characters and peculiarities which appertain not only to the family of which the individual is a member, but also to the species to which he belongs, are conveyed through it from one generation to another. Hence, as the capability of assuming the erect attitude and of thus standing and moving on two feet have been attributes of the human form from its beginning, there can be little doubt that this power is potential in the human organism at the time of birth, and only requires a further development of the nervous and muscular systems to become a reality, without the aid of any special training. The spinal column in the region of the true vertebræ consists of numerous bones jointed together, and with disks of soft fiber cartilage interposed between and connecting the bodies of adjoining vertebræ with each other. It is to their presence that the spinal column owes its flexibility and elasticity. These disks are larger and thicker in the region of the loins, where the lumbar convexity is situated, than in other parts of the column, and there can be no doubt that the acquisition of this convexity is intimately associated with the presence of these disks. It is a matter for observation and consideration to what extent the bodies of the vertebræ contribute to the production of this curve. A few years ago Prof. Cunningham, of Dublin, and I undertook much about the same time researches into the form and dimensions of the bodies of these bones. Our observations were made independently of each other and on two different series of skeletons, and as we arrived at practically the same conclusions, we may, I think, infer that, in their main features at least, these conclusions are correct.

THE SPINAL COLUMN.

The method followed in the investigation was to measure the diameter from above downward of the body of each of the five lumbar vertebræ, both in front and behind. If the upper and lower surfaces of the bodies of the vertebræ were parallel to each other, it is obvious that, so far as they are concerned, the column formed by them would be straight, as in the case in a column built of hewn stones possessing similar parallel surfaces. But if the surfaces are not parallel, the body of the vertebra is wedge shaped; should the front of the collective series of bones have a greater vertical diameter than the back, it is equally obvious that the column would not be straight, but curved, and with the convexity forward. From the examination of a considerable number of spinal columns of Europeans, we found that, although the vertical diameter of the bodies of the two highest vertebræ was greater behind than in front, in the two lowest the anterior vertical diameter so greatly preponderated over the posterior that the anterior vertical diameter of the bodies of the entire series of lumbar vertebræ in each spine was collectively greater than the corresponding diameter of the posterior surface. In twelve European skeletons I observed that the mean difference was between 5 mm. and 6 mm. in favor of the anterior surface. If we are to regard the collective vertical diameter anteriorly of the five bones as equal to 100, the same diameter posteriorly is only equal to 96, which may be regarded as the lumbar index in Europeans. Dr. Cunningham obtained a similar index from the examination of a much larger number of European skeletons, and he further showed that in women the lumbar convexity forward is more pronounced than in men. It follows, therefore, from these observations that when the broad end of the wedge shaped bodies is in front, the bones themselves would, by their form, give a forward convexity to the spine in the lumbar region. But a similar wedge shaped form is also possessed by the lower intervertebral disks in this region, and especially by that interposed between the last lumbar vertebra and the sacrum. Hence it follows that both vertebral bodies and intervertebral disks contribute in the white races to the production of the lumbar convexity. When we pass to the examination of the corresponding region in the spines of those races of men that we are accustomed to call lower races, we find a remarkable and important difference. Let us take, as a characteristic example of a lower race, the aborigines of Australia. In their skeletons our observations have proved that the vertical diameter of the bodies of the five lumbar vertebræ was collectively deeper behind than in front. In my series of skeletons the mean difference was between 6 mm. and 7 mm. in favor of the posterior surface, so that they possessed the opposite condition to that which prevails in Europeans. Hence if the spine had been constructed of vertebræ only, instead of a lumbar convexity, the column would have possessed a forward concavity in that region. For this character, as shown in the skeleton only, I have suggested the descriptive term "Koilorachic." We know, however, that elastic disks are intercalated between the bodies of the osseous vertebræ in the black races as well as in Europeans. It is necessary, therefore, to examine their spinal columns, when the intervertebral disks are in position, in order to obtain a proper conception of the character of the curve in the living man.

(To be continued.)

MERCURY COLUMNS.

AN accurate method of measuring the intensity of fluid or gaseous pressure is indispensable to engineers and physicists, and many forms of apparatus have been devised to meet the requirements of practical use. The Bourdon gage is most commonly used in connection with steam boilers, because it is compact and durable and is sufficiently accurate for all ordinary purposes. Gages in use about steam plants should be periodically tested, however, by comparison with some standard manometer of known accuracy, and as our regular work of boiler inspection requires us to test many thousands of gages each year, we have given considerable thought to the design and construction of standard apparatus for performing such tests with satisfactory precision. Many experimenters in physics have used manometers in which the pressure is measured by the change in volume that is experienced by a given mass of gas inclosed in a graduated glass tube of known capacity.

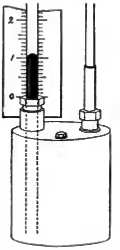


FIG. 1.—A DETAIL OF A MERCURY GAGE.

Nitrogen gas is frequently used for this purpose, because its compressibility has been studied with great care by Amagat. This method of measuring pressures has its advantages, but it has also the marked disadvantage of requiring the observer to note the temperature very accurately, because the volume of the test gas varies with the temperature so notably that a small thermometric error may introduce an error in the reading of the instrument which would be quite inadmissible. In our judgment, the gas manometer is not a satisfactory device for everyday testing purposes. It is much more satisfactory to compare the gage directly with a mercury column, and this is the method that we use in standardizing the test gages that are supplied to our inspectors. The apparatus consists in a pump, by which the gage can be subjected to a water pressure, and a long, vertical glass tube, in which mercury rises to measure the pressure. The mercury is contained in an iron reservoir, as shown in Fig. 1. Two tubes pass out through the top of this reservoir, one of which (shown on the right) transmits the water pressure from the gage table to the mercury reservoir, while the other is the glass tube already referred to, into which the mercury rises. The apparatus is so simple that it hardly needs further explanation, except on the one point of fixing the graduation marks on the scale. This appears to be simple enough, but as we have frequent letters asking how it is done, we shall explain the process of graduation in some detail. Referring to Fig. 2, let us suppose that the diagram on the left represents a little cubical vessel, one inch high, wide and deep, filled with mercury. The weight of the mercury all comes on the bottom of this vessel. Now a cubic inch of mercury weighs about 0·49 of a pound, and hence the pressure on the one square inch that forms the bottom of this little vessel would be 0·49 of a pound. Suppose, now, that we had a similar vessel which is one inch square at the bottom, as before, but which is three inches high, as shown in the middle diagram. This vessel would contain three cubic inches of mercury, and the pressure on the one square inch of its bottom side would be $3 \times 0·49 = 1·47$ pounds. In the same way, if we had a vessel one inch square and (say) 120 inches high, the pressure against the square inch at the bottom would be $120 \times 0·49 = 58·80$ pounds, and so on for any other height. Now let us consider the right hand diagram in Fig. 2. Here the vessel is supposed to be only half an inch square; but it is plain that the pressure per square inch on the bottom of the vessel would be just the same as in the middle diagram, because, although there is only one-quarter as much mercury as before, there is also one-quarter as much area on the bottom of the vessel for it to rest upon; and hence the pressure per unit of area, that is, the pressure per square inch, will be just the same in either case. It will be evident, by this same process of reasoning, that the shape of the cross section of the vessel or tube has nothing to do with the intensity of the pressure. In a word, the pressure exerted by the mercury depends upon nothing but the height of the column; and we can calculate it, in any case, just as though the column were an inch square, as we did in connection with the middle diagram of Fig. 2. In carrying out this idea in the actual work of graduation certain precautions must be observed. For example, we must make sure that the mercury is clean and pure, and that it is not contaminated with tin, or zinc, or lead, or any other substance which may affect its specific gravity. If these substances are present in appreciable amount, the weight of a cubic inch of the mercury will not be the same as the values given in the standard tables, and hence we must either purify the mercury before using it or we must weigh a cubic inch of it very accurately, so as to know by how much it departs from the standard density given in the books. It will be seen that the pressure exerted by a mercury column ten feet high will be one thing in one part of the earth and another thing in some other part. The difference is not very great, it is true, and yet it ought to be taken into account in designing mercury gages for accurate testing purposes. The expression "pounds per square inch" is illogical and meaningless, in the last analysis, although it serves well enough for the ordinary rough work of steam engineering practice. We might speak with accuracy of the number of "poundals per square inch," but this would take us too far away from the conventions of engineering practice; and as a sort of concession to the ordinary, though incorrect, use of the word "pound" as a force, we may adopt the following provisional definition of the word "pound," as it occurs in the expression "pounds per square inch." Definition:

A "pound," in estimating the pressure produced by a column of mercury, is understood to be the force with which the earth attracts a standard avoirdupois pound weight at sea level in the latitude of Washington.

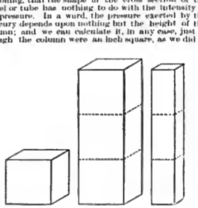


FIG. 2.—ILLUSTRATING THE PRESSURE DUE TO A COLUMN OF MERCURY.

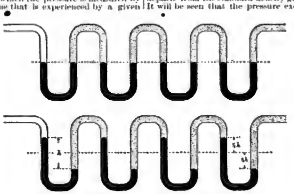


FIG. 3.—ILLUSTRATING THE "SIPHON GAGE."

With this much admitted we are ready to proceed to the problem of graduating our column. It has been found, by careful experiment, that a cubic inch of pure mercury, at 32° Fahr., has a mass of 0·49117 of a pound. Hence, according to the foregoing definition, a column of mercury one inch high gives a pressure of 0·49117 when at a temperature of 32° Fahr. at sea level in the latitude of Washington. If this one inch column of mercury were to be carried toward the equator, or up a hill or a mountain, it would produce a less pressure than this, because the earth would attract it less forcibly in those places. So, too, the pressure produced by a one inch column would be less than 0·49117 pound, if the mercury were warmer than 32° Fahr., because mercury expands upon being heated, and hence it weighs less per cubic inch at higher temperatures. To find the actual pressure produced by a one inch column of mercury, as it stands in the column in our Hartford office, we must therefore take into account three things: (1) the temperature of our column, (2) the difference in latitude between Hartford and Washington, and (3) the elevation of our office above mean sea level. The latitude of our Hartford office being 41° 46', and the temperature of the mercury column being always very near to 70°, we see from the table that it is necessary to allow 2·043 inches for each pound of pressure desired. The best way to carry out the actual work of graduation is probably to lay off, first, the positions of the marks for 10 pounds, 20 pounds, 30 pounds, etc., allowing 20·43 inches for each 10 pounds. Then the intermediate one pound divisions can be filled in upon the skeleton so laid down with great accuracy. The scale itself is best made of well seasoned and varnished pine wood, since the coefficient of expansion of pine is so small that a scale 45 feet long will vary in length by less than the thousandth part of an inch for each Fahrenheit degree of change in its temperature. The scale, when once made and graduated, is to be so adjusted that the mercury column reads accurately zero, when there is no pressure on the testing apparatus. The reading of any mercury gage that is open to the air at one end merely gives the excess of the observed pressure above that of the atmosphere. If the absolute pressure is desired, the reading of the barometer must be noted at the same time, and the atmospheric pressure, so determined, must be added to the reading of the column. When high pressures are to be determined, it is often inconvenient to read the ordinary mercury column, since the top of it is then far above the floor of the testing room. To remedy this difficulty various modifications of the column have been proposed. One of the earliest plans proposed, we believe, by Fahrenheit, is that suggested in Fig. 3. Instead of a single long column we have here a considerable number of shorter ones arranged in U-shaped tubes. The various spaces between the successive lengths of mercury are filled with water or glycerine or some other practically incompressible fluid, which serves to transmit the pressure from each body of mercury to the next. The position of the mercury when in equilibrium under atmospheric pressure at each end is shown in the upper part of the figure. When pressure is applied, the system assumes the configuration shown in the lower diagram, each U of mercury rising in one leg and falling in the other. The head due to each body of mercury is indicated on the left by the letter h, and as will be seen it is equal to double the amount by which the level has risen or fallen in any one leg. The total head of mercury in the entire apparatus is found by multiplying h by the number of U tubes that are present; and a considerable head of mercury can therefore be realized, without the necessity of extending the column to an inconvenient height. The foll head, h, of the mercury in the U tubes cannot be taken in computing the pressure produced by the system, since each of the columns, h, is partially balanced by an equal column of water or glycerine, and allowance must be made for this fact.—The Locomotive.

The longest tunnels in the world are the following, says the Engineering and Mining Journal: Gothard, 14,900 m.; Mount Cenis, 12,220 m.; Arlberg, 10,270 m.; Ronco (Italy), 8,297 m.; Ceylon, 8,000 m.; Hoosac, 7,640 m.; Severn, 7,250 m.; Marioropoli (Italy), 6,480 m.; Sutro (United States), 6,000 m.; Sandbridge (England), 4,970 m.; St. Lawrence (Canada), 4,570 m.

THE

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PAVEMENTS FOR CITY STREETS.

THE street commissioner of St. Louis has issued a very instructive pamphlet illustrated by half-tone engravings, showing the condition of the streets of that city and the methods adopted for paving it. This pamphlet is accompanied with excellent sectional views, showing the method of construction adopted in laying the various forms of pavement. These sections are particularly instructive, as St. Louis includes not only streets where traffic is heavy, but avenues, boulevards, and park roads where the travel is mostly light. By kind permission of the street com[illegible]ssioner, Mr. Abram M. Milner, we are enabled to r[illegible] these sectional views. The report contains ad[illegible]fications which are worthy of adoption [illegible] and though the estimated cost of mat[illegible] is based on the local price in St. Louis [illegible]s are very valuable in estimating in ot[illegible]

The cost of street construction is estimated to be as follows:

STREET CONSTRUCTION.

Estimated cost of materials used in street construction:

Street complete, paved with granite	$30.00 per square.
Street complete, paved with brick	18.00 " "
Street complete, paved with rock asphaltum	$25.00 per square.
Street complete, paved with Trinidad L asphaltum	30.00 " "
Street complete, paved with Telford	10.00 " "

Cost of street paving material:

Preparing roadway	$0.30 per cubic yard.
Telford	4.00 " square.
Macadam	4.00 " square.
Concrete, 6 in. deep	$7.00 per square.
Cinders	2.00 " "
Sand	2.00 " "
Gravel	7.00 " "
Curbing, 6 in. granite, 16 in. deep	1.00 " linear foot.
Curbing, 8 in. oolitic, 16 in. deep	.80 " " "
Combination curb and gutter	$0.90 per linear foot.
Rolling	8.25 " day.
Vitrified brick	11.00 " square.
Granite blocks	25.00 " "
Asphaltum, complete	30.00 " "

Curb stones not to be less than 4 ft. 6 in. long.

Size of granite blocks:

Not less than 9 in. nor more than 12 in. long.
" " " 3½ " " " " 4½ " wide.
" " " 7½ " " " " 8½ " deep.

BRICK PAVEMENT WITH STONE CURB.

TELFORD PAVEMENT WITH CONCRETE GUTTERS.

Size of vitrified brick;

Not less than 8 in.	nor more than	9 in.	long.
" " " 2½ "	" " "	4 "	wide.
" " " 4 "	" " "	4½ "	deep.

Size of vitrified blocks;

Not less than 9 in.	nor more than	12 in.	long.
" " " 3½ "	" " "	4½ "	wide.
" " " 5 "	" " "	6 "	deep.

Cost of granitoid sidewalk:

Single thick, 8 in. cinders, 3½ in. lower course concrete, ½ in. wearing surface .... 14½ cents per square foot.

Cost of a 60 ft. street, 36 ft. roadway, improved with:

Granite..........................	$8.00 per front ft.
Brick	4.50 " " "
Asphaltum.......................	7.00 " " "
Telford...........................	2.75 " " "

Alleys:

15 ft. granite alley............	$2.25 per front ft.
20 " " "	3.00 " " "
15 " brick "	1.40 " " "
20 " " "	1.75 " " "
15 " limestone "	1.00 " " "
20 " " "	1.30 " " "

and of such length as may be directed by the street commissioner.

COLORING.

The wearing surface of the sidewalk pavement, when required, shall be mixed with such color or colors as the street commissioner may direct.

PREPARING THE BED FOR THE SIDEWALK PAVEMENT.

The sidewalks shall be excavated and shaped to the proper depth and grade as directed by the street commissioner, and all the refuse material therefrom shall belong to the contractor and shall be promptly removed from the line of work.

ORDINARY SINGLE FLAGGING.

After the shaping is done, a foundation of cinders not less than eight inches thick shall be placed upon the subgrade, which shall be well consolidated by ramming to an even surface, and which shall be moistened just before the concrete is placed thereon.

After the subfoundation has been finished the artificial stone flagging shall be laid in a good, workmanlike manner.

The same to consist of two parts: First—A bottom course, to be three and one half inches in depth.

Second—A finishing or wearing course, to be one-half inch in depth.

The bottom course shall be composed of crushed

shall have a straight face, fine pean hammer finish on the side toward the roadway for the full depth of the stone, and pitched to line and rough pointed on the side toward the sidewalk, to a depth of six inches from top of curb, and shall have close end joints to the full depth of the stone, and no stone shall be less than four and one half feet long, nor less than six inches thick, nor less than sixteen inches deep. The curbing shall be set on concrete, six inches deep and twelve inches wide, and backed with concrete six inches wide and ten inches deep, or six inches below top of curbing. The quality of the curb shall be equal in material, dimensions and finish to the sample in the street commissioner's office.

Care must be taken not to disturb or break the sidewalk pavement more than necessary, and in all cases, unless otherwise directed, the sidewalk pavement, whenever broken, shall be fully restored.

Whenever the excavation of the roadbed develops too great a width of joint between the old curbing left in position, or openings in the area walls, such joints or openings shall be filled with cement mortar, the mortar being made of one part of cement to one part of sand, or, if necessary, with concrete, as may be determined by the street commissioner.

CONCRETE FOUNDATION.

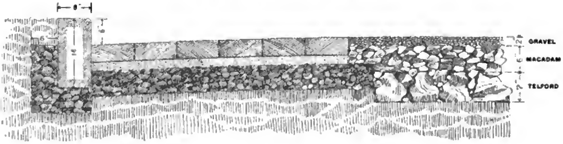
Upon the roadbed a foundation of hydraulic cement concrete shall be laid to a uniform depth of eight

SCALE

1 2 3 4

TELFORD PAVEMENT.

5 FT. VITRIFIED BRICK GUTTER ON CONCRETE BASE. 6 FT. 6 IN. X 6 IN.

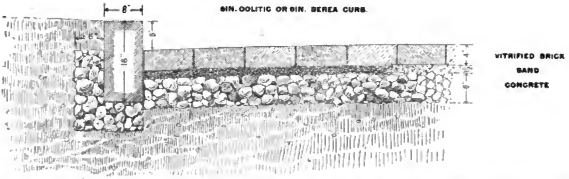


SCALE

0 1' 2' 3'

BRICK PAVEMENT

6 IN. OOLITIC OR 6 IN. SEREA CURB.



The specifications for granitoid sidewalk are as follows.

CEMENT.

All cement shall be fine ground. Eighty five per cent. shall pass through a sieve having ten thousand meshes to the square inch.

All cement shall be capable of withstanding a tensile strain of five hundred pounds per square inch of section, when mixed neat, made into briquettes and exposed twenty-four hours in air and six days under water.

All cement shall be capable of withstanding a tensile strain of two hundred pounds per square inch of section, when mixed in the proportion of three parts sand to one part cement, and exposed twenty-four hours in air and twenty-eight days under water.

All cement shall be put up in well made barrels, and all short weight or damaged barrels will be rejected. Cement without manufacturer's brand and certificate will be rejected without test.

All cement will be subjected to tests for soundness or permanence of volume. All cement for use on the works shall be kept under cover, thoroughly protected from moisture, raised from the ground, by blocking or otherwise, and dry until used. The contractor shall keep in storage a quantity of accepted cement sufficient to insure the uninterrupted progress of the work.

All cement furnished will be subjected to tests of such character as the street commissioner shall determine, and any cement which, in the opinion of the street commissioner, is unsuitable for the work herein specified, will be rejected.

METAL PARTING STRIPS.

The contractor will be required to use metal parting strips, four inches deep, one fourth of an inch wide granite and Portland cement, which shall be mixed in the proportion of one part of cement and three parts of crushed granite.

The crushed granite shall consist of irregular, sharp edged pieces, so broken that each piece will pass through a three-fourths of an inch ring in all its diameters, and which shall be entirely free from dust or dirt.

The crushed granite and the cement in the above mentioned proportions shall first be mixed dry, then sufficient clean water shall be slowly added by sprinkling while the material is constantly and carefully stirred and worked up, and said stirring and mixing shall be continued until the whole is thoroughly mixed.

This mass shall be spread upon the subfoundation and shall be rammed until all the interstices are thoroughly filled with cement.

Particular care must be taken that the bottom course is well rammed and consolidated along the outer edges.

After the bottom course is completed, the finishing or wearing course shall be added. This course to consist of a stiff mortar, composed of equal parts of Portland cement and the sharp screenings of the crushed granite, free from loamy or earthy substances, and to be laid to a depth of one-half of an inch and to be carefully smoothed to an even surface, which, after the first setting takes place, must not be disturbed by additional rubbing.

When the pavement is completed, it must be covered for three days and be kept moist by sprinkling.

GRANITE STREET CONSTRUCTION.

GRANITE CURBING.

The specifications are as follows: All curbstones shall be of the best quality of granite. The curbing

inches. It shall be prepared and applied as herein specified.

SAND.

The sand used in the mortar shall be clean, coarse, screened, Mississippi River channel sand.

CEMENT.

The cement shall be hydraulic cement, equal in all respects to the best Utica or Louisville cement. It shall be newly made, fine ground, ninety per cent. shall pass through a sieve having twenty-five hundred meshes to the square inch, and capable of withstanding a tensile strain of one hundred and fifty pounds per square inch of section when mixed pure, made into briquettes and exposed twenty-four hours in air and six days in water.

All cement shall be in original packages and branded with the name of the manufacturer. Samples for testing shall be furnished in such manner and at such times as may be required. All barrels or packages accepted shall be marked, and the contractor shall carefully preserve these marks and not allow them to be imitated. The cement shall be kept under cover and dry until used, and any cement exposed to the weather after testing shall not be used. Cement may be reinspected at any time when the street commissioner shall so direct, and, if not found to be of proper quality, it shall be rejected. All rejected cement shall be at once removed from the work.

BROKEN STONE OR BROKEN VITRIFIED BRICK.

The material for the body of the concrete shall be composed of limestone or vitrified brick, broken so as to pass through a two inch ring in its largest dimensions. The material shall be free from all dust or dirt. Any stone or broken vitrified brick that is dirty or in-

ferior in quality, or not of proper size, will be rejected, and must be immediately removed from the work.

CONCRETE.

All concrete shall be made of one part of cement, two parts of sand and four parts of broken stone or brick, by volume, all to be of the quality and kind hereinbefore specified.

MORTAR.

The mortar shall be composed of one part of cement and two parts of sand, by volume. The sand and cement to be thoroughly mixed dry in proper boxes, after which a sufficient quantity of water shall be added to produce a mortar of proper consistency and the whole thoroughly mixed.

The mortar shall be mixed fresh for the work in hand, and any mortar which has begun to set shall not be used.

The mortar shall be thoroughly worked and the broken material added, and the whole mass mixed by turning not less than three times on the platform on which the concrete is made. The concrete shall be mixed on a platform prepared for that purpose.

The concrete shall be deposited in place and shall conform to the grade and cross section of the street, to be compacted so as to produce a smooth surface and a uniform distribution of the materials throughout the mass.

No walking or driving over concrete in place shall be permitted when it is setting, and it shall be allowed to set for at least twelve hours and such additional length of time as may be directed by the street commissioner before the pavement is put down. All materials used in the construction of the pavement shall be brought on to the concrete in barrows, or delivered on the concrete from the sidewalk.

PAVEMENT.

On the concrete foundation thus prepared, a bed of clean, sharp sand, free from moisture, two inches deep shall be laid. The granite blocks shall be set stone to stone and hammered tight; the end and longitudinal joints shall be as close as possible; and the longitudinal joints shall be broken so as to leave a lap of at least three inches. The course shall be set at such angles to the line of the street as may be directed.

After a certain number of courses have been set, which shall be determined by the street commissioner, or his duly authorized agent, the joints shall be swept full of sand and each course rammed with a rammer weighing not less than seventy-five pounds. The first ramming being completed, the surface shall be sanded and then wet down with a hose until the water flushes to the surface, after which the ramming shall be repeated, course by course, until the pavement is compact and solid and in conformity with the line and cross grade of the street. The pavement shall then be covered with a uniform layer of coarse, sharp sand, three-fourths of an inch deep.

PAVING BLOCKS.

The blocks shall be of good sound granite, equal in quality and dressing to sample on exhibition at the office of the street commissioner, of uniform grain and texture, free from excess of mica or feldspar. No stone which shows any appearance of disintegration, nor blocks cut from surface stones or bowlders, will be accepted. The blocks shall not be less than nine inches nor more than twelve inches long; not less than three and one-half inches nor more than four and a half inches wide; not less than seven and a half inches nor more than eight and a half inches deep, and dressed so as to approximate closely a rectangular form with opposite faces closely approximating equal areas. All questions in regard to form of block, accuracy of dressing, or quality of stone, shall be determined by the street commissioner, or his duly authorized agent.

BRICK STREET CONSTRUCTION.

OOLITIC LIMESTONE CURBING.

All curbstones shall be of the best quality of hard dark blue oolitic limestone from quarries of established reputation, free from seams or other defects. All curbing shall have close end joints to the full depth of the stone, and no stone shall be less than four and one-half feet long nor less than eight inches thick, and not less than sixteen inches deep. Each stone shall have parallel sides. The edge toward the roadway shall be rounded with a radius of one and one-half inches. The curbing shall be set on concrete six inches deep and fourteen inches wide, and backed with concrete six inches wide and ten inches deep, or six inches below top of curbing.

Curb to be dropped four inches or more at all driveways, unless otherwise ordered. The quality of the curb shall be equal to the sample in the street commissioner's office.

CONCRETE FOUNDATION.

Upon the roadbed a foundation of hydraulic cement concrete shall be laid to a uniform depth of six inches. (See Concrete Foundation in Granite Street Construction.)

VITRIFIED BRICK WEARING SURFACE.

Upon the foundation of concrete shall be laid a bed of coarse, screened sand, one and one-half inches in thickness when compacted, to serve as a bed for the bricks. Upon this base of sand a pavement of the best quality of vitrified paving brick shall be laid. The

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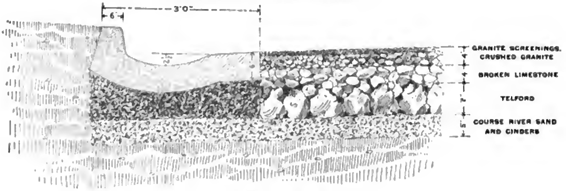
IMPROVED TELFORD

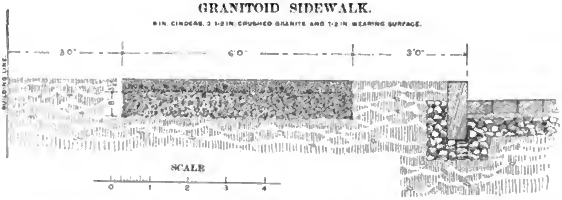
3 FT. GRANITOID CURB & GUTTER ON 8 IN. CINDERS.



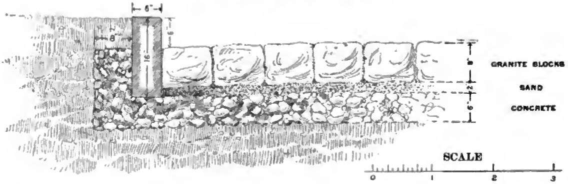
CROSS-SECTION OF

GRANITOID SIDEWALK.

8 IN. CINDERS, 3 1-2 IN. CRUSHED GRANITE AND 1-2 IN. WEARING SURFACE.



GRANITE PAVEMENT



bricks shall not be less than eight inches nor more than nine inches long, not less than two and one-half inches nor more than three and one-half inches wide, not less than four inches nor more than four and one-half inches deep, with rounded edges with a radius of three-eighths of an inch. Said brick shall be of the kind known as "repressed" brick, and shall be repressed to produce a mass free from internal flaws, cracks or laminations.

The bricks shall be free from lime or other impurities that will injuriously affect them when immersed in water, uniform in size and quality, and thoroughly burned and annealed.

All brick so distorted in burning, or with such prominent kiln marks as to produce an uneven pavement, shall be rejected.

Each bidder shall submit one hundred bricks, which shall be subjected to such physical tests as may, in the opinion of the street commissioner, be necessary to determine their quality and suitability for the work.

To secure uniformity in bricks of approved manufacture, delivered for use, the following tests shall be made:

1. They shall show a modulus of rupture in cross-breaking of not less than twenty-five hundred pounds per square inch.

2. Specimen bricks shall be placed in the machine known as a "Rattler," twenty-eight inches in diameter, making thirty revolutions per minute. The number of revolutions for a standard test shall be eighteen hundred, and if the loss of weight by abrasion or impact during such a test shall exceed thirty per cent. of the original weight of the bricks tested, then the bricks shall be rejected. An official test to be the average of two of the above tests.

No bid contemplating the use of rejected brick shall be entertained.

Samples may be submitted by manufacturers, in which case the bidder proposing to use brick of such manufacture will not be required to submit samples. The quality of the brick furnished must conform to the samples presented by the manufacturers and kept in the office of the street commissioner.

The street commissioner reserves the right to reject any and all bricks which, in his opinion, do not conform to the above specifications.

Any brick may have a proper shrinkage, but shall not differ materially in size from the accepted samples of the same make, nor shall they differ greatly in color from the natural color of the well burned brick of its class and manufacture.

No bats or broken bricks shall be used, except at the curbs, where nothing less than a half brick shall be used to break joints. The bricks to be laid in straight lines and all joints broken by a lap of at least two inches, to be set on edge on the sand as closely and compactly as possible and at right angles with the line of the curb, except at street intersections, where they are to be laid as the street commissioner may direct.

The pavement to be thoroughly rammed two or three times with a paver's rammer weighing not less than seventy-five pounds. The pavement to be surfaced up by using a long straight edge and by a thorough rolling of the pavement with a road roller weighing not less than three nor more than six tons, and when completed to conform to the true grade and cross section of the roadway.

All the joints in the pavement shall be completely filled with Portland cement grout. The cement to be of brand approved by street commissioner, to be fine ground; 85 per cent. shall pass through a sieve having 10,000 meshes to the square inch. All cement shall be capable of withstanding a tensile strain of 500 pounds per square inch of section, when mixed neat, made into briquettes and exposed 24 hours in air and 6 days under water. All cement shall be put up in well made barrels, and all short weight or damaged barrels will be rejected. Cement without manufacturer's brand and certificate will be rejected without test.

The grout shall be mixed in portable boxes in the proportion of 1 part cement to 1 part sand. The cement and sand to be thoroughly mixed together dry, then sufficient water to be added to make the grout of proper fluidity when thoroughly stirred.

The grout shall be transferred to the pavement in hand scoops, or as the street commissioner may direct, and rapidly swept into the joints of the pavement with proper brooms.

Teams, carts and wagon traffic and wheeling in barrows, except on plank, will not be allowed on the pavement for at least 7 days after the grout is applied.

The surface of the pavement, when completed, shall be covered with ½ inch of clean, coarse sand, of approved quality, which, with all dirt, shall be removed from the pavement and sewer inlets by or at the expense of the contractor at such time before the final acceptance of the work as the street commissioner may direct.

ROCK ASPHALTUM PAVEMENT.

The foundation is the same as granite or brick.

WEARING SURFACE.

Upon the base thus formed shall be placed a wearing surface as follows:

A mixture of American bituminous rock, which shall be prepared and laid on said concrete base as follows: The wearing surface shall be composed of bituminous sand rock from the Chickasaw Nation or Breckinridge County, Ky., 66⅔ to 50 per cent.; bituminous lime rock from the Buckhorn mines in the Chickasaw Nation, 33⅓ to 50 per cent. The rock of both materials shall be ground finely and thoroughly mixed and nothing shall be added to or taken from the powder obtained by grinding the bituminous rock. This pow-

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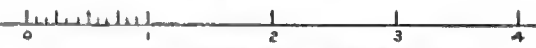
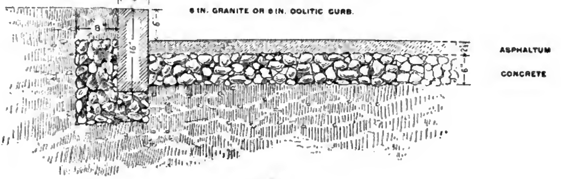


ASPHALTUM PAVEMENT

6 IN. GRANITE OR 6 IN. OOLITIC CURB.



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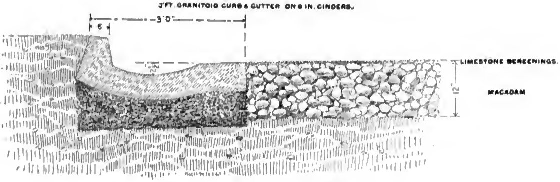
MACADAM PAVEMENT

3 FT. GRANITOID CURB & GUTTER ON 6 IN. CINDERS.



PARK ROAD

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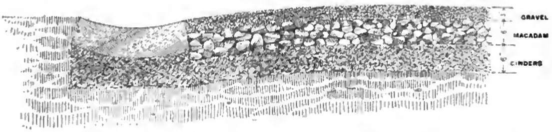
2 FT. X 6 IN. GRANITOID GUTTER



der shall be heated in a suitable apparatus to a temperature of from 150° to 200° Fah.; it shall be brought to the street in suitable carts and spread with rakes to an even thickness of such depth as will insure a uniform thickness of 2 inches after having received its ultimate compression. The surface shall then be compressed by tamping and rolling, after which a small amount of hydraulic cement will be swept over it, and then it will be thoroughly compressed by a steam roller weighing not less than 5 tons.

The bituminous sand rock shall contain from 9 to 12 per cent. of pure bitumen. The bituminous lime rock shall be as nearly as possible a pure carbonate, thoroughly and evenly impregnated with asphalt having no more impurities than the standard German rock asphalt of Limmer or Vorhole, and shall contain not less than 7 per cent. and not more than 12 per cent. of bitumen, according to the richness of the bituminous sand used.

The other illustrations show a Telford pavement with vitrified brick gutter; an improved Telford pavement with granitoid curbs; a Macadam pavement with granitoid curbs, and a park road. They are model pavements, and, with the aid of the foregoing specifications, no further description seems necessary. Valuable papers on roadways and street pavements will be found in our SUPPLEMENT, Nos. 971, 828, 578, 476, 567, 843, 826, and 845.

[Continued from SUPPLEMENT, No. 1135, page 18137.]

PERPETUAL MOTION.—V.*

CARNOT'S OPINION OF PERPETUAL MOTION.

THE celebrated physicist and mathematician Carnot has given his opinion on "perpetual motion" as follows:

From what we have observed regarding friction and other passive forces, it may be inferred that perpetual motion is a thing absolutely impossible, when only such bodies are employed as are not acted on by motive power, or any heavy body; for, as these passive forces, which cannot be avoided, are constantly resisting, it is evident that the movement must continually abate; and from what has been said, it will be seen that, when

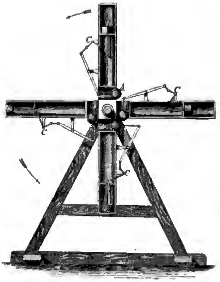


FIG. 22.

bodies are not acted on by any motive power, the sum of active force will be reduced to nothing: that is to say, that the machine will be brought to rest when the amount of activity absorbed by friction, since the commencement of the movement, will have become equal to one-half of the initial active force; and when the bodies are weights, the movement will terminate when the amount of activity absorbed by the friction equals one-half of the initial active force. Moreover, one-half of the active force existing, if all the parts of the system have a common speed, equals that which is due to the height of the point where, in the first instance of the movement, was the center of gravity above the lowest point to which it can descend.

It is easy to apply the same reasoning to constructions where springs are used, and generally to all such constructions where, abstracting from friction, the moving force, in order to bring the machine from one position to another, must consume an amount of activity as great as that which is absorbed by the resisting forces when the machine returns from the last to the previous position.

The movement will terminate still sooner, if any percussion takes place, as the sum of active force is always diminished in such cases.

It is therefore evident that one must altogether despair of producing what is called the perpetuum mobile, if it be true that all the motive powers existing in nature consist in nothing but attraction, and that it is a general property of this power to be always equal at equal distances between given bodies; that is to say, to be a function that only varies in cases where the distance of these bodies varies itself.

This opinion may be appropriately followed by that of Dr. Lardner, given in the following extract:

There is no mechanical problem on which a greater amount of intellectual ingenuity has been wasted than that which has for its object the discovery of the perpetual motion. Since this term, however, is not always rightly understood, it will be useful here to explain what the perpetual motion is not, as well as what it is.

The perpetual motion, then, which has been the subject of such anxious and laborious research is not a mere motion, which is continued indefinitely. If it were, the diurnal and annual motion of the earth, and the corresponding motions of the other planets and satellites of the solar system, as well as the rotations of the sun upon its axis, would be all perpetual motions.

To understand the object of this celebrated problem,

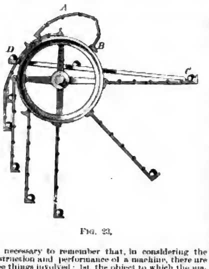


FIG. 23.

it is necessary to remember that, in considering the construction and performance of a machine, there are three things involved: 1st, the object to which the machine gives motion; 2d, the construction of the mechanism; and 3d, the moving power, the effect of which is transmitted by the machine to the object to be moved. In consequence of the inertia of matter, the machine cannot transmit to the object more force than it receives from the moving power; strictly speaking, indeed, it must transmit less force, since more or less of the moving force must be intercepted by friction and atmospheric resistance. If, therefore, it were proposed to invent a machine which would transmit to the object to be moved the whole amount of force imparted by the moving power, such a problem would be at once pronounced impossible of solution, inasmuch as it would involve two impracticable conditions: first, the absence of atmospheric resistance, which would oblige the machine to be worked in a vacuum; and second, the absence of all friction between those parts of the machine which would move in contact with one another.

But suppose that it were proposed to invent a machine which would transmit to the object to be moved a greater amount of force than that imparted by the moving power, the impossibility of the problem would in this case be still more glaring; for, even though the machine were to work in a vacuum, and all friction were removed, it could do no more than convey to the object the force it receives. To suppose that it could convey more force, it would be necessary to admit that the surplus must be produced by the machine itself, and that, consequently, the matter composing it would not be endowed with the quality of inertia. Such a supposition would be equivalent to ascribing to the machine the qualities of an animated being.

But the absurdity would be still greater, if possible, if the problem were to invent a machine which would impart a certain motion to an object without receiving any force whatever from a moving power; yet such is precisely the celebrated problem of the perpetual motion.

In short, a perpetual motion would be, for example, a watch or clock which would go as long as its mechanism would endure, without being wound up; it would be a mill which would grind corn, or work machinery, without the action upon it of water, wind, steam, animal power, or any other moving force external to it.

It is not only true that such a machine never has been invented, but it is demonstrable that so long as

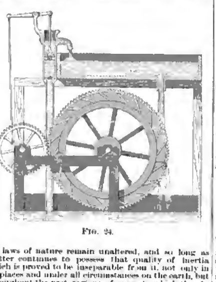


FIG. 24.

the laws of nature remain unaltered, and so long as matter continues to possess that quality of inertia which is proved to be inseparable from it, not only in all places and under all circumstances on the earth, but throughout the vast regions of space to which the observations of astronomers have extended, the invention of such a machine is an impossibility the most absolute.

Fig. 22 is a drawing of a supposed perpetual motion, which the inventor says will not go, though he has worked at it twelve months. He has now given it up in despair, and vows he will waste no more time upon it. The central weights, A, each weigh one-fourth more than the weights, B, at the extremities of the arms. The two sets of weights are connected pairs, each pair being joined by a lever, link and bell crank, C. The action of gravity in the central weights compels the sliding weights at the ends of the arms to assume the positions shown in the engraving.

Had our correspondent, Mr. George C. Phillips, of Alleghany, Cal., applied a little mathematical calculation to the verification of the truth or falsity of the principle of his device, he might easily have proved that it was a perfect balance, and saved himself twelve months of trouble and expense. The leverage of the outside is exactly counteracted by the leverage of the inside weights.

Fig. 23 is a device contrived by Mr. George Linton, of Middlesex, England. The engraving is an end view of a series of vertical wheels, one only being seen. The lever, A, is represented in the act of falling from the periphery of the wheel into a right line. The lever is composed of a series of flat rods, connected by ruler joints, which said ruler joints are provided with a stop, or joggle, to prevent their collapsing at any time more than will bring any one of the rods which compose the levers at a right angle with the rod next to it. This lever is attached to the periphery of the wheel by the hinge joint, B, provided with the shoulder, to prevent its falling into any other than a right line from the center of the circumference of the wheel. The levers are furnished at their outer extremities with a bucket, or receiver, the bottom of which is sufficiently broad to retain the ball, C. The balls remain in the buckets till the buckets come into the position of the lever, D, when they are expected to roll out of the buckets on to the inclined plane, and by their own gravity roll to the other end of the inclined plane, ready to be again taken into the buckets.

Fig. 24 shows a principle so often employed for the production of self-moving machines that it ranks next to that of perpetual eccentric weights in its delusive power upon minds of inventors. The attempt to compel a water wheel to raise the water which drives it is in one form or other perpetually recurring in devices

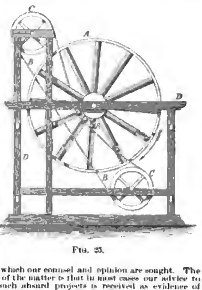


FIG. 25.

upon which our counsel and opinion are sought. The worst of the matter is that in most cases our advice to drop such absurd projects is received as evidence of our want of sagacity and knowledge, and our would-be client becomes the dupe of some not over-conscientious patent agent, who pockets his fees and laughs in his sleeve at the greenness of the applicant.

The device illustrated is one submitted by one of these enthusiastic individuals, who, without understanding the first principles of mechanics, believes he is about to revolutionize the industry of the world by his grand discovery; and as honor, and not pecuniary reward, is his object, he seeks to make public his invention through the wide circulation of this journal. He is quite willing we should adversely criticise the device, because its merits are so great that no amount of skepticism resulting from our blind prejudice can, he thinks, influence candid minds against a principle so obviously sound and sublimely simple. It is unnecessary for us to describe the device, as it explains itself. The inventor has not tried it to see whether it will work. What need when anyone can see on paper that "it must go"?

Fig. 25 represents an attempt at securing the desired object by means of eccentric weights, kept so by means of an endless belt and pulleys, of which the inventor thus writes:

"The annexed drawing shows how I have at length taken this enticing jilt (perpetual motion), though after a long and weary chase

'Through pleasant and delightful fields,
Through barren tracks and lonely wilds;
'Mongst quagmires, mosses, muirs and marshes,
Where dell or spunkie never scarce is!
By chance I happened on her den
And took her where she didna ken.'

"A represents a wheel with twelve hollow spokes, in each of which there is a rolling weight or ball. It is a belt passing over two pulleys, C. There is an opening round the wheel from the nave to the circumference, so as to allow the belt to pass freely and to meet the weights. The weights are met by the belt as the wheel revolves, and are raised from the circumference until they are at last brought close to the nave, where they remain till, by the revolution of the wheel, they are allowed to roll out through the circumference. By this

* Reprinted from the SCIENTIFIC AMERICAN, 1870-71.

arrangement the weights are one side of the wheel, always at the circumference, so that that side is more powerful than the other, which causes the wheel continually to revolve. D is the frame of the machine. The arrow points out the direction in which the wheel turns."—Dixon Vallance, Liberton, Lanarkshire, November 10, 1825.

In 1612 Thomas Tymme, professor of divinity, published a philosophical dialogue, in which he discourses of the perpetual motion invented by Cornelius Van Drebble, a Dutchman, who was engineer to King James in England.

Tymme's work is a small quarto. The author's name on the title papers occurs in the smallest type. It is repeated again in full—"Thomas Tymme"—both to the dedication "To the Right Honorable Sir Edward Coke, Lord Chief Justice," etc., etc., and also The Address to the Readers, which latter concludes:

"And for that rare things move much, I have thought it pertinent to this Treatise, to set before thee a most strange and wittie invention of another Archimedes which concerneth Artificial perpetual motion, imitating nature by a lively patterne of the Instrument It Selfe, as it was presented to the King's Most Royall hands, by Cornelius Drebble, of Alchmar in Holland, and entertained according to the worthinesse of such, a gift my paines herein bestowed and intended for thy profit and pleasure, if it seeme but as iron, yet let it serve for the Forge and Anvil of good conceit, if the discourse seeme rough, shadow it, I pray thee, with the curtaine of smooth excuse," etc.

The work is divided into two parts, the first containing six, the second four chapters.

"Chap. 3 concerneth the nature and qualitie of the earth: and the handling of a question whether the earth hath naturall motion or no.

"Also herein is described an Instrument of Perpetuall Motion, as stated in the list of Contents."

At page 56 commences chapter 3, from which we extract the following:

"Philadelphia—For as much as the Earth and Sea make but one globous body united and combined together, I pray you describe the form thereof to me."

This is explained by Theophrast—the dialogue occupying four pages. At last he says:

" . . . And to make plaine the demonstration unto you, that the Heavens move and not the earth, I will set before you a memorable Modell and Patterne, respecting the motion of the Heavens about the fixed earth, made by Art in the immitation of Nature, by a gentleman of Holland, named Cornelius Drebble, which instrument is perpetually in motion without the means of Steele, Springs, and waights.

"Phil.—I much desire to see this strange Invention. Therefore, I pray thee, good Theophrast, set it here before me, and the use thereof.

"Theo.—It is not in my hands to show, but in the custody of King James, to whom it was presented. But yet behold the description thereof here after fixed.

"Phil.—What use hath the globe marked with the letter A?

"Theo.—It representeth the Earth; and it containeth in the hollow body thereof divers wheels of brasse, carried about with moving, two pointers on each side of the Globe does proportion and shew forth the time of dayes, moneths, and yeeres, like a perpetualle Almanacke.

"Phil.—Both doth it also represent and set forth the motions of the Heavens?

"Theo.—It setteth forth these particulars of Celestiall motion. First the houres of the rising and setting of the Sunne, from day to day continually. Secondly, hereby is to be seene, what signe the Motion is in every 24 houres. Thirdly, in what degree the Sunne is distant from the Moone. Fourthly, how many degrees the Sunne and Moone are distant from us every houre of the day and night. Fifthly, in what signe of the Zodiacke, the sun is every Moneth.

"Phil.—What doeth the circumference represent, which compasseth the Globe about?

"Theo.—That circumference is a ring of Cristall glass, which being hollow, hath in it water, representing the sea, which water riseth and falleth, as doth the flood, and ebbe twice in 24 houres, according to the course of the tides in those parts, there this instrument shall be placed, whereby is to be seene how the Tides keepe their course by day or by night.

"Phil.—What meaneth the little globe above the ringe of the Glasse?

"Theo.—That little Globe as it carrieth the forme of moone cressent, so it turneth about once in a moneth, setting forth the encrease and decrease of the Moone's brightnesse, from the wane to the full, by turning round every moneth in the yeere.

"Phil.—Can you yeeld me any reason to perswade me concerning the possibility of the perpetuity of this motion?

"Theo.—You have heard before that fire is the most active and powerful Element, and the cause of all motion in nature. This was well knowne to Cornelius, by his practise in the untwining of the elements, and therefore to the effecting of this great worke, he extracted a fierie spirit, out of the minerall matter, joining the same with his proper aire, which encluded in the Axletree, being hollow, carrieth the wheeles, making a continuall rotation or revolution, except issue or vent be given to the Axletree, whereby that imprisoned spirit may get forth. I am bold thus to conjecture because I did at sundry times pry into the practise of this gentleman with whom I was very familiar. Moreover, when as the King, our Soveraigne, could hardly believe that this motion should be perpetuall, except the misterie were revealed unto him; this cunning Bezaleel, in secret manner, disclosed to his Majestie the secret, whereupon he applauded the rare invention. The fame thereof caused the Emperor to entreat his most excellent Majestie to license Cornelius Bezaleel to come to his Court, there to effect the like Instruments for him, sending unto Cornelius a rich chaine of gold.

"Phil. It becometh not me to make question concerning the certaintie of that, which so might Potentates out of the finity of their wisdomes have approved, yet me thinketh that time and rust which corrupteth and weareth out all earthly things, may bring an end to this motion in a few yeeres.

"Theo.—To the end of time may not weare these wheeles by their motion you must know that they move in such slow measure that they cannot weare and the losse, for that they are not forced by any poyse of waight. It is reported in the Preface of Euclydes Elements, by John Dee, that he and Hieronimus Cardanus saw and Instrument of perpetuall motion, which was solde for 20 talents of gold, and after presented to Charles Fift Emperour; wherein was one wheele of such invisible motion that in 70 yeeres onely his owne period should be finished. Such slow motion cannot weare the wheeles. And to the end rust may not cause decay, every Engine belonging to this Instrument is double gilded with fine gold, which preserveth from rust and corruption.

"Phil.—This wonderful demonstration of Artificiall motion, immitating the motion celestiall, about the fixed earth doth more prevaill with me to approve your reasons before alleadged, concerning the moving of the Heavens, and the stability of the Earth then can Copernicus assertions which concerne the motion of the Earth. I have heard and read of manie strange motions artificiall as were the inventions of Boetius."

After enumerating these and others Phil. concludes:

"These were ingenious inventions, but none of them are comparable to this perpetuall motion here described, which time by triall in ages to come, will much commend.

"Theo.—These great misteries were attained by spending more oyle than wine; by taking more paines than following pleasure."

(To be continued.)

SHOULD GENERATING PLANT BE MOUNTED ON SPRINGS?*

By JAMES SWINBURNE, M.Inst.C.E.

THIS is really part of a larger question: Should moving machinery be mounted on springs? The question concerns both the health of the moving machinery and of the people who may be moved by it. In central stations and in passenger steamers the shaking caused by machinery is most serious; in flour mills, for example, it is rather a question concerning the gear itself.

If we consider, say, a direct acting pump in space, it is a system that of course cannot move its center of gravity as a whole. If, then, its pistons and plunger move in one direction, the rest must move in another direction, the distance depending on their masses. Any imperfectly balanced machinery must therefore move its bedplate if freely suspended. A perfectly balanced engine is thus an engine whose center of gravity never varies relatively to its bedplate. This definition is really too small, because a moving system, such, for instance, as two cranks at 180 deg. on opposite ends of a shaft, do not change their center of gravity, but give the bedplate a rocking but nontranslational movement. A gas engine with a flywheel, similarly, tends to rotate its bedplate at each impulse round an axis parallel to that of the shaft. A balanced engine is therefore really one which does not move its bedplate if freely suspended. Such an engine is practically never realized.

When an engineer sees an engine bedplate moving, his first instinct is to bolt it down; it then moves a little less, but still moves, and he has a sort of feeling it must shake itself to pieces if allowed to move. Bolting down an engine to a bed of concrete is merely increasing the size of its effective bedplate, but the whole bedplate, including the concrete, must now be moved. It rests on the earth, moves slightly, and communicates vibration to neighbors who are longing to be compensated for disturbance.

Sometimes the concrete bedplate is isolated by mounting it on felt; that means that the larger bedplate is mounted on rather imperfect springs.

A rather striking case is that of church bells. Bells are very much out of balance, and the bedplates are mere cages of timber; so the bedplates would tend to move a good deal. The bell people do not like to see it move, so they wedge it to the steeple, and the result is a cracked steeple. The consequence is that you often hear that such a church has a very fine peal of bells, but they cannot be used, as the steeple will not stand it. Though this may be a relief to people whose ears are in tune, it might be cheaper not to make bells than to make them and hang them so that they cannot be used.

The question is, if the bedplate of an engine wants to move, why should it not have free play? As far as the engine goes, a little thought will show that all its parts are subjected to smaller stresses if the bedplate is free to move. An engine will therefore wear longer if it is allowed to move its bedplate. As to the foundations, if the bedplate is allowed to move, no foundations to speak of are needed; and there is no vibration communicated to the ground.

The writer has tried this arrangement on a small scale. There is a small dynamotor on one of the top floors of Mr. Crookes' house which is very much out of balance, and rendered the house uninhabitable at first. It is now on springs and makes no noise. There is also a dynamotor for electrolytic work in the writer's laboratory. It has no springs, and no one has any inkling of a chance of complaining.

In passenger steamers the throb of the engine is exceedingly unpleasant; in fact, many people would rather go by a slower boat than travel 21 knots and be at the same time shaken 42 more knots by his pedometer. Mounting marine engines on springs seems rather a bold suggestion, and perhaps we ought not to begin there. The moving systems are so heavy in proportion to the fixed (or "attached" is the better word) that the marine engine is a particularly difficult case.

The idea of mounting engines and dynamos on springs was mooted by the writer in Industries in 1892. The editor, in addition to being a sound engineer, is a man of caution, so the communication came out as an anonymous letter. Mr. W. W. Beaumont has, however, done a great deal of real work on the subject, especially in connection with flour mills. He has introduced his "vibromotor" principle. This principle is simple, "If gear wants to wobble, let it wobble." The idea seems sound. The discussion will perhaps throw new light on it.

* Paper read at the Institution of Civil Engineers. Engineering Conference. Section VII. Applications of Electricity.

The administration of oxygen is of great benefit in the case of carbon monoxide poisoning.—Stahl und Eisen.

SELECTED FORMULÆ.

Electro-plating Aluminum with Copper.—According to a continental contemporary, it is possible to obtain adhesive coats of copper on aluminum by the following method: First clean the aluminum in a warm solution of an alkaline carbonate, thus making its surface rough and porous; it is next washed thoroughly in running water, and dipped into a hot solution of hydrochloric acid of about 5 per cent strength, again washed in clean water, and then placed in a somewhat concentrated acid solution of copper sulphate, until a uniform metallic deposit is formed; it is then again thoroughly washed and returned to the copper sulphate bath, when an electric current is passed until a coating of copper of the required thickness is obtained.

Photographic Intensification.—A method of optical intensification of a weak negative, due to Lord Rayleigh, is too valuable to be overlooked. It is based upon a well known principle. A piece of colored glass looks twice as intensely colored when placed upon a sheet of white paper. A feeble transparency is similarly intensified. In both cases the light rays have to traverse the absorbing layer twice over. For the white paper a silver-on-glass mirror may be advantageously substituted. The film of the negative is placed in contact with the silver, and illuminated by a candle or other small source of light. It is then photographed in the usual manner. To get rid of surface reflection a wedge shaped plate of glass is laid over the negative.—Rayleigh, Phil. Mag., Sept., 1897.

Model Face Powder.—The Pharmaceutische Rundschau says that a good face powder must contain snow-white steatite, light calcium carbonate, zinc white and wheat or rice starch. Flesh color for blonds is produced by carmine and the tint for brunettes by burnt umber or sienna. Orris is best for scent. The following ideal cosmetic powder is constructed from these ingredients:

Zinc white	500	parts.
English precipitated calcium carbonate	8000	"
Steatite, best white	500	"
Wheat or rice starch	1000	"
Triple extract white rose	30	"
Triple extract jasmine	30	"
Triple extract orange flower	30	"
Extract cassia	30	"
Tincture musk	8	"

Mix thoroughly by repeated siftings. Orris root in powder may be substituted for the perfumes.—Pharmaceutical Era.

Pumice Stone for Filtering.—English pharmacists are generally familiar with the valuable properties of pumice stone as a filtering medium, which Busch (Pharm. Centralh., xxxviii, 424) has lately recommended as a novelty for filtering liquids which contain minutely distributed precipitates (such as barium sulphate, lead sulphate, calcium oxalate), likely to pass through the filter. The very finest pumice stone powder must be used, and it must have been freed from all acid-soluble impurities. Two to three grains of the powder are put on the point of the filter, and a clear filtrate is said to be obtained after the first few drops.

Detection of Glycerine in Sirupy Liquids.—Denigès recommends heating a small quantity of the liquid with three or four times its weight of powdered bisulphate of potassium. Any acrolein vapors which may have formed are detected by Nessler's reagent, or they are passed into a hot mixture of 2 c.c. of a 1 to 2 solution of silver nitrate, 2 c.c. of solution of ammonia and 2 c.c. of solution of soda. The reduction of the silver solution indicates the presence of glycerine.—Pharm. Centralh., xxxviii, 427.

New Dental Filling Material.—The following mixture under the name of "aluminized gutta percha" is recommended by Bliss as a filling:

White gutta percha	8
Aluminum filings	5
Oxide of zinc	1
Whiting	½

The filling is said to be easily manipulated, free from bulging and to hold its position in the cavity when firmly packed.—Journ. Brit. Dent. Ass., xviii, 401, after Pac. Stomat. Gaz.

Coloring Silver.—A rich gold tint may be imparted to silver articles by plunging them into dilute sulphuric acid, saturated with iron rust.—La Science en Famille.

Blacking Copper.—To give a copper article a black covering, clean it with emery paper, heat gently in a Bunsen or a spirit flame, immerse for 10 seconds in a solution of copper filings in dilute nitric acid, and heat again.—Revue Scientifique.

Waterproof Floors.—Flooring may be made impermeable by painting it with a solution of paraffin wax in kerosene. The coat lasts for two years.—Uhland's Wochenschrift.

Soldering Cast Iron.—To solder cast iron, clean the place to be soldered well, then brush it with a brass wire brush until the iron becomes yellow. It will be found that the solder can now be applied without any trouble.—La Science en Famille.

Developing Powders.—A developer in powder form, suitable for taking on tours, is prepared as follows:

A

Metol	7	parts.
Hydroquinone	18¼	"
Powdered eikonogen	10½	"
Powdered boric acid	4½	"

Mix this well and keep in a well stoppered yellow bottle.

B

Sulphite of soda	45	parts.
Borax	10½	"
Sugar of milk	10½	"

This may be kept in a white bottle. For use take:

Water	100	parts.
Powder A	2	"
Powder B	4	"

For bromide paper use double the amount of water.—La Vie Scientifique.

ENGINEERING NOTES.

An overhead cable tramway, from Dyea to the Klondike mines, is proposed by L. R. Radcliff, of St. Louis. The St. Louis Republic says that he is now preparing to ship his cables and machinery to Seattle and thence to the far North, with the intention of building his tramway in the next spring and have it in working order over the pass for the following winter. Meanwhile he also proposes warehouse stations along the proposed line, to be worked by burros for the transport of miners' supplies.

A railway to India, from Alexandria to Agra and Bombay, is proposed by C. E. D. Black, in a paper read before the English Society of Arts. The line would be 2,400 miles long, from Port Said to Kurrachee, and would cross upper Arabia to Basra, at the head of the Persian Gulf; and skirt the north shore of the gulf and the Arabian Sea to Kurrachee, on the border of India. Mr. Black advocates the route for political purposes mainly, though he thinks the revenue would be sufficient to pay a fair interest on its estimated cost of $75,000,000.

Success appears to have attended the experiment made last December on the New Haven Railroad, and duly reported at the time, in the sheathing of a passenger car with copper. In this case the usual sheathing was removed from a first-class car, the frame was redressed and blocked and the metal sheathing was prepared in the company's shop, the process being slow, as the work was out of the usual line. It was thought that the copper might add considerably to the weight of the car, but since the completion of the work it has been found that the thinner car sheathing is not desirable, for the reason that the lips of the grooves in the edge are inclined to curl, there not being sufficient lumber in the upper lip to make it firm. All the posts and corners, in fact, every exterior part of the passenger car made of wood, were covered with copper. The car has been run since January without interruption, and no appreciable evidence of expansion has been noted during exposure to heat or cold, and the stiffness of the material prevents bad appearance on the board. Some eight hundred to nine hundred pounds of metal are required.

The greatest steam hammer of Germany is still the one called "Fritz," at the Krupp Works in Essen, but, although great care had been taken in providing a very strong foundation, it has settled almost 10 inches. The construction of the foundation was started in a hole 40 feet deep on a grill made of piling. Then there comes a deep layer of sawdust, upon which very large and heavy cast steel blocks solidly fastened to each other are resting. Next follow three alternate layers of heavy wooden planking and more steel blocks. On top there is a layer of cork 40 inches thick, carrying the anvil block, which weighs upward of 30 tons. This foundation has to carry a total weight of about 2,300 tons, and, in consequence of its settling, the hammer is but seldom used now, having been replaced by a hydraulic press able to exert a pressure of 12,500 tons. This hydraulic press is the largest at the present time in Continental Europe, England being the only country having one of the same size, at the foundry of Beadmore, at Parkhead. In this connection it may be interesting to note that the Bethlehem Iron Works have now a hydraulic press furnishing an equivalent of power of 14,000 tons pressure.

That galvanized sheets which are made of steel with the oxide formed in rolling removed, and then coated with spelter, are not more generally used in boiler or tank works is because the advantages thereof are not sufficiently understood, says the American Boilermaker. The extreme cheapness of steel plate and improvement in manipulating same has been followed by the general substitution of steel plate stacks and chimneys for brick. It is, however, well for boilermakers to remember that the action of moisture, especially when impregnated with sulphur arising from soft coal, has a destructive influence on steel plates, rusting rapidly, particularly in the lighter gages. This may be delayed by frequent painting or varnishing. The coating of spelter of steel sheets is impervious to moisture, and therefore the life of the metal is preserved indefinitely, especially where it may be painted with the ordinary commercial stack or boiler paints. We would remind boilermakers that, unless they call the attention of their customers to this fact, they will find a large and profitable part of their business leaving them on account of the short life of the ordinary steel stack as now made, because the first cost of the brick chimneys will be of less importance than the inconvenience and cost of having to replace a steel stack or chimney.

Various plans have been suggested at different times for the utilization of the energy developed by the rise and fall of the tides, but the intermittent character of the power has usually prevented any satisfactory solution of the problem. There is, however, one instance in which tide power has been quite successfully applied in a very simple manner. Along the river front at Liverpool there is a tendency for the accumulation of silt against the dock walls, requiring occasional dredging for its removal. Instead of using scoop dredges, this mud is removed at different periods by the use of tide power in the following manner: Along the base of the dock walls is laid a pipe, perforated with holes, directed outward, this pipe being connected with the interior of the dock system, and suitable valves being provided to permit or to check the flow of water. When the tide is very low, and consequently the head of water measured from the surface in the docks is at its greatest, a sudden opening of the connection permits a rapid flushing action by the water escaping through holes in the pipe at the base of the walls, scouring out the mud and driving it out into the river to be carried away. As the tides at Liverpool average about 25 ft. or more, it is evident that this simple form of dredging apparatus may be very effective, and as the time chosen for using it may be selected when the supply of water is greatest, it does not interfere with the regular use of the docks. Ultimately, no doubt the introduction of practical and economical forms of power storage will render the equalization of tide power commercially practicable, but at the present time this example serves to demonstrate the fact that solar and lunar attraction, as expressed by the tides, have been harnessed in a small way at least.

ELECTRICAL NOTES.

A telephone connection between Frankfort-on-the-Main (Germany) and the chief towns of Switzerland is planned.—Electrotechnische Rundschau.

Herr Otto Reincke remarks that wines and beer are cleared much more quickly of any suspended matter if under direct strong light. He has tried the effect of the light from an electric lamp, and has found that a very quick clarification could be effected by the action of its rays on the beverage.—Wochenschrift für Brauerei.

The great station of the Niagara Falls Power Company is being extended 286 ft., making its total length 436 ft., which will accommodate ten of the 5,000 horse power units, three of which are already in place and seven more contracted for, the Westinghouse Company supplying the generators and the I. P. Morris Company the turbines, as before.

In Baar, Switzerland, there is a 10,000 spindle cotton mill run by electric power from the Rhone, which is only 550 feet away, says the Electrical Review. There are three motors kept in a separate room to protect them from the dust, and of these one drives the openers, cards, combing machines, drawing and flier frames, and supplies 200 lamps; another drives the mules, and the third the ventilating fan and workshop.

It is said that interesting experiments are being carried on by the Carnegie Steel Company at its Homestead Works in heating steel billets by electricity, says the English Electrical Review. Economy in fuel and a saving in time required to heat the billets are claimed. It is also asserted that the billets are heated from the center to the outer surface, insuring equal heat throughout the mass. The steel thus treated is reported to be of better quality, from the fact that the exact temperature may be obtained without overheating.

At Genoa (Italy) a peculiar accident recently occurred. A troop of soldiers were on their way to their drill, and were led by Lieutenant Tallio. The latter was crossing the tracks of the electric cars, when his horse stumbled, and knocked its head against one of the iron posts which carry the wires. A long spark shot out of the post and killed the horse instantly. The lieutenant was unhurt. The company explained the fact, saying that in a recent thunderstorm the post had been struck by lightning, and the insulation destroyed, so that the horse short-circuited the rails and the wires.—Electrotechnische Rundschau.

The electric current is supplied by some companies at a tariff based on the use of lamps of a definite candlepower. In many cases, either intentionally or by error, lamps of too high a candlepower are used. Thus the company is defrauded of its due. A device has now been introduced which makes it impossible to use lamps of a higher candlepower than provided by the tariff. Within the threaded socket of the lamp are placed a series of rings, varying in number according to the candlepower of the lamp, such of low candlepower having more rings than those of higher candlepower. Consequently, a lamp inserted in a socket intended for one of higher candlepower produces no contact, and therefore gives no light.—Stahl und Eisen.

"**The only** tramway company in Siam," says Mr. J. Barrett, in the Street Railway Journal, "is the Bangkok Tramways Company, which has been organized several years and is doing a very successful business. It began with horse cars, but now has as good an electrical equipment as most lines in America. When the system was changed from horses to electricity, the contract for dynamos, rolling stock and work of alteration was given to an American firm, who sent out a competent engineer to superintend it. From the very first day that the line was operated by electricity it has paid handsome dividends, never less than 8 or 10 per cent. and running up in one or two years to 15 or 18 per cent. per annum. The Siamese government has been favorably disposed to the company from its inception, and the King is a large stockholder. The Siamese people seem to have no prejudice whatever against this or other modern systems of rapid transit, and crowd the cars at every trip. The line has been so prosperous that it is running all the cars possible. It has a single track, with switches about every quarter of a mile, the streets being too narrow for a double track. The road runs right away from the lower end of the city in the heart of the shipping interests to the royal palace, a distance of fully six miles, through the principal thoroughfare. . . ."

The principal feature of the Cowper-Coles gold recovery process is an aluminum cathode which overcomes one of the chief difficulties appertaining to the economical recovery of gold from weak cyanide solutions by electrolysis, says The Engineer. In the Siemens-Halske process lead foil or lead strips are used, the cutting up of which is a tedious matter. If several sheets are cut superimposed, the strips cling together, and have to be carefully spread out one by one, so that the surface may be exposed to the solution. A clean-up is made every seven to eight weeks, when the wood frames carrying the lead strips are withdrawn, the lead strips removed and new substituted, the auriferous lead being ultimately melted down, and conveyed to a central works to be cupeled. This method is both crude and expensive, the labor of fitting the strips into the frames is considerable, and the consumption of lead is a large item, having been computed by Mr. Von Gernet at the Worcester Mine at 1·10 of a penny per ton of ore treated. The Cowper-Coles process overcomes these difficulties, aluminum plates being substituted for the lead foil, advantage being taken of the fact that a loose oxide is formed on the surface of the aluminum which enables the deposited gold to be readily stripped or wiped from the cathodes as pure gold. Gold by this process has been successfully extracted from cyanide solutions containing only 0·01 per cent. of cyanide of potassium, 2¼ dwt. of gold to the ton of solution. The substitution of aluminum for lead foil, or strip, enables the gold to be obtained as pure gold, and also daily returns to be made of the amount of gold recovered; it also has the additional advantage of reducing the cost of labor and economizing the amount of cyanide of potassium used, as the solution is not contaminated by any base metals such as zinc, as in the other processes.

MISCELLANEOUS NOTES.

The population of Algiers has risen from 4,164,158 in 1891 to 4,394,129 in 1896. These numbers include the French troops: 345,337 are French, 3,755,917 are Mohammedans of French nationality, the remainder consists of Spaniards, native Jews, Italians, Tunisians, Moors, Maltese, Germans, and others.—La Science en Famille.

Herr Russner, in Mittheilungen aus der Praxis des Dampfkessel- und Dampfmaschinen-Betriebes, 1896, states by using a covering of zinc plate on steam pipes, leaving a layer of air between the pipe and the covering, the condensation can be much reduced. Experiments with this contrivance gave results which compare by no means unfavorably with those of the ordinary non-conducting coverings, while the new arrangements have certain advantages which the author points out.

There are several breweries in Japan which are in keen competition both as regards the inland supply and the export. Their prosperity is best shown by the rise in the fortunes of the greatest among them, the "Nihon Bakushu-Kwaisha." Five or six years ago this company was very near bankruptcy, but in 1895 it sold three times as much beer as in 1892. Its shares advanced from 40 yen to 80 yen and from 12½ yen to 34 yen. The exports of German beer to India and other parts of Asia have gone down in the proportion of 9·5 : 8.

Herr Salzenberg has devised a system of incandescent gas burners in which the gas is used at a high pressure. For the source of pressure he uses the water pipes. With his burner a candle power of 850 to 1,000 is obtained by the combustion of 230 to 300 liters of gas and about a cubic yard of water per hour. From one mantle two and one-half times as much light can be obtained as from an arc lamp, the expenses being much lower—the arc lamps burning in Germany costing about fifteen cents per hour, the incandescent gas three cents.—Uhland's Wochenschrift.

A great many toys are now made in this country, including many mechanical devices. Many toys are still imported. Such things as woolly sheep and dogs, now as highly prized by children as ever, come from Germany, as do the skin-covered horses. They could be made here, but they can be produced cheaper abroad. As a rule, whatever can be made by machinery is made here, while toys made by hand are mostly imported. The minute a thing is brought within the reach of machinery, American manufacturers can pay their higher prices for labor and still beat the world. With the low prices of labor in foreign countries, hand-made productions can be made cheaper in them. As a result of this there are toys of some kinds which in their completed state are partly American and partly foreign. Among these are toy vehicles with horses attached. The vehicles and everything in and about them may be the product of American machinery, while the horse standing between the shafts may be from Germany.

The separation of tin and wolfram ore has been successfully accomplished by means of the Wetherill magnetic concentrator, says the Iron and Coal Trades Review. The ore upon which the experiments were made was from Spain, and consisted of cassiterite contaminated by wolframite. Wolfram in tin ore is a very objectionable element, and ordinarily its elimination involves a tedious and unsatisfactory process. Simple mechanical separation is impossible, since the specific gravity of wolframite is very similar to that of cassiterite. With the Wetherill machine, however, a nearly perfect separation was effected. The wolframite, besides being removed from the tin ore, was converted into a clean, marketable product for ferro-tungsten manufacture. The ores of which wolfram was the bane are no longer very important sources of tin supply, and the Bohemian and Saxon mines which furnish a good deal of wolframite have comparatively little cassiterite associated with them, so that the scope of the Wetherill machine is limited to the inferior Spanish ores, which were the subject of the experiments.

According to Dingler's Polytechnisches Journal, July 9, the question of carborundum versus emery is at present occupying much attention in Europe, says the Engineering and Mining Journal. In emery the abrasive material is crystallized aluminum oxide; in carborundum it is carbide of silicon. Although carborundum is much harder, its crystalline structure is less favorable for grinding than is emery. The crystals of carborundum are long and narrow, with few cutting edges and smooth faces, while emery crystals are nearly cubical and have rough surfaces. Perhaps the greater hardness of carborundum is offset by the better cutting properties of the emery. This is also indicated by the difficulty in keeping carborundum wheels from glazing when too much slag is used in making them. The author of the paper quoted concludes that emery has the advantage over carborundum for grinding or polishing purposes in all cases except where the finest grades are used. For the latter, carborundum seems to be the better.

The Chemiker Zeitung in a recent issue says that in aluminum castings a distinction must be drawn between castings which are practically finished on leaving the mould and castings which are subsequently subjected to a forging or rolling process. The difficulty of producing sound aluminum castings lies in the great contraction of the metal on cooling. This difficulty can be overcome by adding phosphorus to the molten metal, in the proportion of about one gramme to one kilogramme. Thoroughly sound castings are obtained in this manner, but they are rather brittle, and therefore unfit for rolling purposes. Castings suitable for the last named process are obtained by pouring some rape oil upon the surface of the metal, which is fused in iron crucibles. When all the oil is burnt off, the metal is run in the hot iron moulds, and as soon as the contraction begins more metal is added. The ingots obtained in this way are excellent for rolling, forging or wire drawing purposes. Aluminum fused in graphite crucibles always has a tendency to crack in the rolling or forging, the more so the oftener it has undergone the process of melting in this kind of crucible. This appears to be due to the fact that aluminum takes up silicon from the crucible.

EXPERIENCES IN THE ARCTIC SEAS.

FREDERICK G. JACKSON, the leader of the Jackson-Harmsworth polar expedition, has given, in a recent issue of the London Graphic, an interesting account of his experiences in Arctic exploration and describes as follows how he happened to make his first voyage to the polar regions:

It was in the winter of 1887, while in the Southern States of America, that I received a cablegram from a friend, who, being aware of my desires, told me that if I could be ready to go, and in Peterhead within three weeks, a passage had been offered to me in a whaler leaving that port in the first week of March. In three days I had settled up my affairs and left on the first stage of my journey toward the north. The voyage I then embarked upon in the good ship Eric, under the able command of Captain Alec Gray, in some respects changed my preconceived notions of the world within the Arctic circle and enlarged my ideas, but without reducing my enthusiasm in the smallest degree.

In 1892 I drew up and made public the plans upon which my recent expedition was based, and with the object of testing my equipment and obtaining some practical experience of sledging and camp life during an Arctic winter, in the summer of 1893 I embarked upon one of the vessels of the Yenesei expedition and was landed with my stores and sledges at the Yugor Straits. Here I was able, in the company of two Samoyads, to map in and explore the island of Waigatz, which is of special interest from being the holy island of these remarkable northern people. To certain sacred spots these Samoyads, from the whole of Northern Siberia and Russia, make pilgrimages, traveling frequently many thousands of miles with this object, and taking sometimes months on the journey. Returning south, I then passed through and mapped the Bolshaia Zemelskija Tundra country, having engaged Samoyads and reindeer for the purpose, and was able to put to severe tests the various parts of my equipment which I intended to use on my Franz Josef Land expedition.

On this journey, after reaching comparative civilization, I fell in with and experienced the great value of the hardy northern Russian horses that I then determined to make use of on that expedition, and which have since fully justified my most sanguine expectations and have done us such good service. On reaching the vice-consulate at Archangel I there found Her Majesty's representative, Mr. Cooke, who gave me a most hearty reception and handed me a cablegram requesting me to return to England with all speed, as the money necessary for my expedition to Franz Josef Land had been found by Mr. Harmsworth, who had even requested Mr. Cooke to dispatch a small expedition in the direction of Khabarova to look for me. This, I felt, was a truly satisfactory result of my journey.

I wished, however, instead of returning via Petersburg, the shortest route, to go round the White Sea and through Lapland, with the object of making further inquiries, of gaining more experience of reindeer, and of studying the clothing and equipment of the Lapps. This I satisfactorily accomplished, and the results, I felt, quite justified the time expended upon this second portion of my long sledge journey.

The next five months were occupied in a great scramble to get everything ready for the expedition to Franz Josef Land. Hurry and bustle was the order of the day, but with very few things in an incomplete condition we sailed in the steam yacht Windward for Franz Josef Land on July 11, 1894. At Archangel we called for a log house we had made and erected with numbered joints to facilitate our again building it in Franz Josef Land. Here we also took on board our four ponies and the bulk of our furs. Our reception by the governor and officials was warm and hospitable in the extreme, and we left the last of civilization behind us carrying pleasant remembrances with us. The next point we made for was Khabarova, where the previous year I had spent some time, and here we took on board thirty dogs brought from the neighborhood of the Ob River for our expedition, and after obtaining a supply of reindeer meat, we steamed north for Franz Josef Land, and our real difficulties began. How we at last got through the icy barrier on September 7, erected our living and store houses and landed our goods upon Cape Flora, and the ship became frozen in for the winter, has already been told.

The following spring, as soon as daylight returned, we began pushing forward toward the north our food depots, in accordance with my plans. In this we were aided enormously by the small horses which we had brought forward with us from Archangel for the purpose, and by the beginning of May we reached latitude 81 deg. 20 min. N., established four food depots at suitable distances apart, and had conveyed north two boats for future use, in addition to making many important geographical discoveries and collections of all kinds. Open water then absolutely stopped our advance, and we were obliged to return to Cape Flora with all speed to avoid losing our ponies owing to the early break up of the ice.

Just prior to our leaving on this journey, a very heavy gale of wind broke up the ice around the ship, and placed her in some peril for a time. A boat lying alongside was swept away, and various other damage was done. As this now left the ship short of boats all hands were set to work to dig two, which I had reserved for the use of the land party, out of the deep snow drifts in which they were buried, and one was taken on board the ship. Directly after the Windward left us in July, we departed on a boat journey along the southwestern coast, and succeeded in adding to Mr. Leigh Smith's discoveries in that direction.

The following winter was passed as comfortably and busily as the previous one and with an equal freedom from illness, and early in the next spring we again started with our sledges north. It was on this journey that my conviction that Franz Josef Land, so far from being a large continental mass as was generally supposed, was in reality but an archipelago of comparatively small islands was confirmed. Open water again met us in the attempt to pass our highest northern latitude of the previous year, but, fortunately, we were able to turn our hands to other geographical work by confirming and adding to that done by us then. The following summer we were fully occupied with scientific work of all kinds, and in the middle of June we met with Nansen and Johansen on their way to the south, having made their wonderful and plucky sledge journey from the farthest north. Never in my life did I experience such keen pleasure as when I was able to welcome these two wanderers to Elmwood and could bid them cast aside their sledges, "kayaks" and "ski," and take their well earned rest. The following winter we were still busier, if possible, than the two that had gone before. New tents, new traces, another canoe, and a thousand and one things had to be attended to. Our absolutely good health still continued, thanks to our doctor's good care of us, and to the ready manner in which the necessary health regulations were complied with by one and all.

On hearing from Dr. Nansen of the non-existence of land to the north, coupled with my own experiences, I decided on completing the map of Franz Josef Land before trying to reach north over the moving pack, and with this object Mr. Armitage and I proceeded up the western shores of the British Channel, of which I completed the mapping, and after a rather tiresome journey of two months, on which, owing to the severe weather, we lost nearly all our draught animals, we succeeded in completing the whole of the western and northwestern shores of Franz Josef Land, and in settling, in my opinion, the for so long vexed question of Gillis Land.

Evia House, on Bell Island, was the scene of a very pleasant little meeting as we neared home. The doctor, having got anxious, owing to our prolonged absence, accompanied by Messrs. Bruce and Wilton, started with a sledge load of provisions to look for us toward the west, but they had only gone ten miles when, on coming up to the hut on Bell Island, they found us encamped inside it.

We remained for ten days at Cape Flora to refit, and Mr. Armitage and I again left with a team of eight rather weak dogs, as I had now hardly any serviceable animals to go east. After doing very well indeed at the outset, when in the neighborhood of Brady Island our sledge broke through the very thin ice, and as we lost all our provisions except a little food put out for lunch, and the ice proving weak in every direction, there was nothing for it but to return. Our chief festivals at Elmwood were Christmas Day, New Year's Day, and birthdays, more especially that of the Queen, when the large jack was run to the head of the flagstaff, and we drank Her Majesty's health in the wine which we kept for such occasions.

FEEDING AN INFANT POLAR BEAR—JACKSON-HARMSWORTH POLAR EXPEDITION.

The post office is laying an underground telegraph cable from London to Birmingham, one of the main reasons of their adopting a long underground trunk line being the difficulty in finding overhead routes. Any additions to the present telephone trunk lines will of course be made above ground, so that it has been deemed advisable to make use of cable for the supplementary telegraph lines which are now required. The cable contains seventy-six conductors laid up in nineteen fours, each conductor weighing 150 lb. per mile. The sets of four conductors are separated by a cross shaped paper core, being held in place by a single lapping of paper, and the nineteen strand is again surrounded by a lapping of broad paper strip. Both these papers are laid on "half-lap," so that each lapping is equivalent to two thicknesses of paper. The whole is contained in a thick lead covering. Work has been begun at Watford, and about nine miles of cable have been laid on each side of the town. The cables are, says the Electrician, drawn into 3 in. cast iron pipes, 30 miles of piping having already been put down. It is intended to use the dry air system to keep up the ventilation of the line.

THE "HEAVY WEIGHTS" COMPETITION OF THE AUTOMOBILE CLUB.

DESPITE the pessimistic predictions of some, the competition of "heavy weight" vehicles (for so they have been styled), which has just taken place (after beginning on the 1st of August and continuing six days), has proved a genuine success for French industry. The minister of war appointed a committee to follow its operations, and several illustrious foreigners came to Paris to be witnesses of it.

This international competition was open to all mechanical vehicles, arranged with a view to the following service:

(1) The carriage of passengers, the vehicles accommodating at least 10 persons and 600 pounds of baggage; and (2) the carriage of freight, and the simultaneous carriage of passengers and freight, with a minimum weight of one ton.

Three itineraries had been selected, having gradients reaching 2 inches to the foot. The carriages started from and returned to Place d'Armes, at Versailles.

The three itineraries were as follows:

A.—St. Cyr, Villepreaux, Noisy-le-roi, Roquencourt, Garches, Saint Cloud, Point-du-Jour, Sèvres, Viroflay and Versailles—say 24·3 miles, 6¼ of which were paved roads, with two refreshment stations.

B.—Ville d'Avray, Montretout, Suresnes, Porte-Maillot, Rueil, Saint Germain, Marly-le-Roy, Roquencourt and Versailles—say 27·5 miles, 3¾ of which were paved roads, with two refreshment stations.

C.—Vaumurier, Dampierre, Cernay-la-Ville, Gif, Palaiseau, Jouy-en-Josas and Versailles—say 39½ miles, of which 6¼ were paved roads, with four refreshment stations.

Each competing vehicle had to pass over each route twice at a speed that was fixed in advance, so that the obstructing of the roads should be reduced to a minimum. The entire journey to be made was thus 183½ miles, 33 of which were over paved roads. One or more judges upon each carriage noted all the important data, incidents or accidents, etc.

We have no intention of giving the details of the competition in this place (for the report that the Automobile Club is preparing will alone be able to teach us as to the official figures taken), but shall be content to calculate the daily total mean speed of each vehicle. The results, of course, are merely approximate, but they nevertheless give indications that are sufficiently practical. This said, we shall pass very rapidly in review the principal types of carriages that competed, in classifying them in three categories: (1) The omnibuses of Messrs. De Dion-Bouton, Panhard, Scotte and Weidknecht; (2) the trains and pleasure cars of Messrs. De Dion-Bouton, Le Blant, and the Maison Parisienne and Scotte; (3) the freight traction engines of Messrs. Dietrich & Scotte.

The De Dion-Bouton Omnibus (Fig. 4).—This carries 16 passengers and their baggage, say 1,050 pounds, and its motor is of 25 horse power. In this vehicle, the builders have employed those parts that have already been put to the test in their steam brakes, etc. (boiler, engine, direct transmission to the wheels, etc.) The engine is placed under the carriage properly so called, and actuates the hind wheels. In front, above the steering train, is placed the boiler, with the conductor and the fireman. The speed upon a level is capable of reaching 10 miles an hour. In reality, the mean speeds (all stoppages included) were: In itinerary A, 7 and 6 miles an hour; in itinerary B, 5½ and 8 miles an hour; and in itinerary C, 8¼ and 5½ miles an hour.

The Panhard Omnibus (Fig. 6).—This carries 10 passengers and 180 pounds of baggage. It is provided with two coupled Daimler-Phenix vertical gasoline motors of 6 horse power, so that in reality it is a 4 cylinder, 12 horse power motor, which is placed under the front seat, and actuates the hind wheels. The transmission is effected through gearings and chains with four differential speeds.

The weight, in running order, is 7,920 pounds. The speed on a level reaches 10 miles an hour. In reality, the mean speeds (all stoppages included) were: Upon itinerary A, 6 and 5 miles an hour; upon itinerary B, 4¼ and 5 miles an hour; and upon itinerary C, 5½ and 4½ miles an hour.

The Scotte Omnibus (Fig. 1).—This carries 12 passengers and their baggage. The motor, which is of 16 horse power, is placed in front, above the steering train. The transmission is by gearings and chains, with two different speeds. The driving wheels are in the rear. The weight, in running order, is four tons. The speed on a level is 9 miles an hour. The mean speeds (all stoppages included) were: Upon itinerary A, 4¼ and 4¼ miles an hour; upon itinerary B, 6 and 4¾ miles an hour; and upon itinerary C, 4¼ and 4¾ miles an hour.

The Weidknecht Omnibus.—This vehicle is of the General Omnibus Company's type of 30 seats. The steam motor, of 34 horse power, acts through chains upon the large front wheels, the steering wheels being behind. The weight in running order is 6 tons. This vehicle was obliged to stop at the end of the third day, in consequence of an accident to the frame. Its mean speed was 3, 3¼ and 3¾ miles an hour upon the three itineraries.

The De Dion-Bouton Traction Engine (Fig. 5).—This hauls a long pleasure car, and has the same mechanical arrangements as the omnibus. It has a seating capacity for 32 passengers without baggage. The mean speeds (all stoppages included) were: Upon itinerary A, 5¼ miles an hour; upon itinerary B, 5 and 5 miles an hour; and upon itinerary C, 4½ and 3½ miles an hour.

Let us say, apropos of this latter figure, that, in consequence of an accident to a connecting rod, the vehicle had to make the second half of its trip with a single engine.

The Le Blant Brake.—This is a carriage that is now old, since it was constructed as far back as 1892, and took a prize in 1894, at the Paris-Rouen competition.

It has accommodations for 12 passengers and 1,100 pounds of baggage. The steam motor is of 12 horse power. The vehicle was put out of service on the very first day, in consequence of a fire occasioned by the smoke stack.

The Maison Parisienne Pleasure Car.—This has accommodations for 12 passengers. It is provided with a 9 horse power ho[illegible]tal gasoline motor of the Benz type. The trans[illegible]on is by belts. Its weight, in running order, is [illegible] pounds. It was run with but half a load, which will throw it out of the competition. Under these conditions it made the average speeds of 5, 6½ and even 8 miles an hour.

The Scotte Train (Fig. 2).—This consists of a motive vehicle, with a seating capacity for 14 persons, hauling a carriage with accommodations for 18 persons and 2,100 pounds of baggage. It is provided with a 16 horse power steam motor having the same mechanical arrangements as those of the omnibus. The mean speed on a level is from 7 to 8¾ miles an hour. The actual speeds obtained were: Upon itinerary A, 4¼ and 4¼ miles an hour; upon itinerary B, 5½ and 4¾ miles an hour; and upon itinerary C, 4¼ and 4½ miles an hour. The running was very regular and sure. Besides, let

FIG. 1.—GENERAL VIEW OF THE SCOTTE OMNIBUS.

FIG. 2.—SCOTTE PASSENGER TRAIN.

FIG. 3.—SCOTTE FREIGHT TRAIN.

FIG. 4.—DE DION-BOUTON OMNIBUS.

FIG. 5.—DE DION-BOUTON TRACTION ENGINE AND PLEASURE CAR.

us recall the fact that an analogous train has been running for a few months past for the public service between Courbevoie and Colombes.

Dietrich's Freight Truck.—This is provided with a 7 horse power gasoline motor, and carries a load of 2,640 pounds. The average speeds (all stoppages included) varied from 4 to 5¾ miles an hour.

The Scotte Freight Train (Fig. 3).—This consists of a traction engine that carries 2¼ tons and of a 9 ton flat car, say 12 tons in all, in running order. The mechanical arrangements are analogous to those of the omnibus and passenger train. The speed on a level is from 4¾ to 6 miles an hour. The mean speeds obtained (stoppages included) varied from 3 to 3¾ miles an hour.

We shall draw no conclusions from the figures that we have just given, having desired merely to present the principal types of the vehicles that competed. After the official report of the Automobile Club of France has been made public we shall be able to appreciate the relative value of the different systems. Let us say merely that the Versailles competition showed that several carriages were capable of a normal and assured operation, and that among these must be mentioned the systems of Scotte, De Dion-Bouton and Panhard and Dietrich.—La Nature.

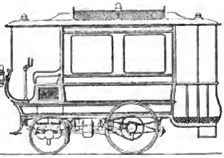


FIG. 6.—PANHARD OMNIBUS.

[Continued from SUPPLEMENT, No. 1135, page 18140.]

THE SPREAD OF LAND SPECIES BY THE AGENCY OF MAN; WITH ESPECIAL REFERENCE TO INSECTS.*

By LELAND O. HOWARD, Ph.D.

THERE remains one more source of accidental introductions, and it is one which has been reasonably prolific as regards insects on several occasions. I refer to international expositions, which are now becoming of almost annual occurrence. At the Centennial Exposition at Philadelphia, in 1876, the insects occurring in the exhibits, especially of foreign grains, received some study by Dr. Riley, who published a short note in the Proceedings of the St. Louis Academy of Science for October 2, 1876. A special committee of the Philadelphia Academy, consisting of Drs. Horn, Leidy and Le Conte, also prepared and published a report at this time, but none but well known and cosmopolitan forms were found. I am not familiar with the results of any studies of a similar nature made at the Paris Exposition Universelle of 1889, but have seen the title of a paper by M. Decaux which reads "Études sur les insectes nuisibles recueillis à l'Exposition Universelle," Paris, 1890, which, however, I have not been able to consult.

In 1893, however, careful observations were made at the World's Fair at Chicago by Mr. F. H. Chittenden, the results of which were published by Dr. Riley in Volume VI of Insect Life. Insects to the number of 101 species were found in grain and other stored vegetable products. Seven species were found affecting animal products and 13 wood-feeding species were found in the forestry building. The interesting and significant fact is mentioned in this article that there was an exchange of seed samples between the representatives of different countries, which would of course greatly facilitate the spread of seed-inhabiting insects, and it was further shown that thousands of samples were taken away from open bags by visitors from all parts of this country and probably from other parts of the world. Moreover, at the close of the Exposition the sheaves of cereals used in the decorations were taken away by armfuls by visitors. After summarizing the habits and countries of origin of the different species, however, Dr. Riley expressed the opinion that no dangerous importations were made at this time. It seems altogether likely, however, that Phyllotreta armoraciæ, a European species which has established itself in northern Illinois, Iowa and Wisconsin since 1893, and which was found by Mr. Chittenden in that year in vacant lots near the exposition grounds, was an exposition importation. Moreover, an interesting Carabid of the genus Tranes, the species of which are all Australian, has established itself injuriously in greenhouses in St. Louis as the result of the introduction of two plants of Zamia spiralis which were bought at the World's Fair. With these instances in mind we cannot but admit that other species heretofore overlooked probably escaped and have become acclimatized as the result of this exposition, and that such occasions, occurring as they do more and more frequently and drawing constantly increasing material from all parts of the world, will, unless precautionary measures are instituted, afford more and more frequent opportunities of a very favorable kind for the spread of injurious species.†

We have thus seen how great the opportunities are under our modern conditions for the transportation, in proper condition for establishment, of insects of many groups, and from this point of view it seems strange, in view of the very numerous importations, that more species do not become acclimatized even in North America, where, perhaps, we reach the greatest possibilities in this direction. Our most intimate commercial relations are with the great faunal region most like our own, and these relations are rapidly growing both with Europe on the east and with Asia on the west, although our Asiatic importations are more abundant from the Oriental region than the Palearctic, and from the Oriental we are not so likely to receive species which will acclimatize themselves. We have already pointed out that the faunistic relations with the Coleoptera (and undoubtedly with other groups) are least marked between the north temperate and south temperate regions, and this distinction is never likely to be disturbed by imported species on account of the diametrically opposed seasons. A species starting from Argentina in the height of summer will reach the United States in the dead of winter at a time least likely to favor its acclimatization. This point was first suggested by my colleague, Mr. E. A. Schwarz, in his paper entitled "The Coleoptera Common to North America and Other Countries." (Proc. Entom. Soc. Wash., I, 182-194.)

It appears from what we have shown that very many species are constantly being imported which do not become acclimatized. Many of the European species which we should most expect to take hold in this country have not done so, while with others it is the unexpected which has happened. As Osten Sacken says, speaking of the Diptera: "Importation will not occur for centuries in cases where it might be expected from day to day; and, again, it will sometimes take place under circumstances most improbable, and, à priori, impossible to foresee." (Proc. Entom. Soc. Lond., 1894, p. 480.)

Why should the well known Pieris rapæ have made its appearance in this country and spread far and wide, while the equally common and injurious Pieris brassicæ and P. napi have never been found here? Why should Phytonomus punctatus have flourished with us when it is hardly known as a clover enemy in Europe, and when the congeneric Phytonomus meles, of Europe, has never been found here? Why should Coleophora laricella have established itself here and none of the other European Coleophoras (some of them of much greater distribution and hibernating in cases of protective coloration and shape, and attached to plants) have acclimated themselves among us? Why should Calliphora vomitoria, Cyrtoneura stabulans and Stomoxys calcitrans have been brought over at an early date and flourished to excess in America and many other countries, while Sarcophaga carnaria is unknown in any of them?

Mr. Schwarz has phrased it: "We stand here before some great unknown factor, viz., the individual character and inmost nature of the species which governs the introduction or non-introduction of each species—a factor which is variable according to each species . . . ." But there is no reason why a mystery need be made of this condition. In a word, it is the capacity of the individual species to accommodate itself to a more or less novel environment. Nowhere in the whole animal kingdom do we find the natural environment more complicated than with insects. Conditions are frequently dependent upon conditions in an almost endless chain. The phenomena of fatal parasitism are of vital importance as determining the abundance of the species and are curiously complicated. I have recently proved the existence of several fatal tertiary parasites and the probable existence of quaternary parasites with Orgyia leucostigma in Washington. Upon the condition of this chain of interdependencies rests the welfare of the primary host. If adverse conditions affect the quaternary parasite, the primary host suffers, for the tertiary parasites increase and kill off the secondary parasites, allowing an increase of the primary parasites which kill off the Orgyia. The famous instance of Darwin in which he showed that in a measure cats are responsible for the production of clover seed in England through the interrelations of cats, field mice and bumble bees, is paralleled and outdone again and again among insects. Further, in no group of animals are the characteristics termed special protective resemblance and special aggressive resemblance, to say nothing of protective and aggressive mimicry, so well marked and so important in the life of the species as with the insects. It is upon the degree of simplicity of its life—the degree of simplicity of its normal environment as a whole—that the capacity of a species for transportation and acclimatization, even into a parallel life zone, depends.

Nevertheless, I am fully convinced that very many more species will stand transportation from the Palearctic to the Nearctic, from the Australian to the Oriental and the Neotropical regions, than would be supposed from a consideration of these points and from a knowledge of the comparatively few forms which have as yet been transported and acclimatized. Aside from the forms brought in with their food and thus under the most favorable conditions for establishment, it is only by a lucky chance with the average accidental insect immigrant that it finds conditions for reproduction—a chance which may not occur once in very many times. Osten Sacken has pointed out that Eristalis tenax must have been brought here many times during four hundred years before it succeeded in establishing itself. Undoubtedly many of these immigrants die upon our wharves when a lucky chance like crawling upon the clothes of a person and thus being carried out into the country might have resulted in the establishment of the species. Given the most favorable conditions, and many species will be able not only to accommodate themselves to a new environment, but certain of them will thrive better in the new than in the old. The effort to transport beneficial species from the Australian region and acclimatize them in the Nearctic region seemed a rash and unprofitable experiment on its face, and I confess that I for one had little hope of its success, yet it was successful with several species and transcendently successful with one.

Much has been written of late about the success of the work in the introduction of beneficial insects by Mr. Albert Koebele into Hawaii, under the auspices of the Hawaiian government. Some of the introductions seem, without doubt, to have been strikingly successful. Mr. R. E. C. Perkins has reported at some length upon this success and, in commenting upon its reasons, says:

"It becomes natural to ask why the success of the imported beneficial insects has been so pronounced here, while in other countries it has been attained in a comparatively small measure. The reason, I think, is sufficiently obvious. The same causes which have led to the rapid spread and excessive multiplication of injurious introductions have operated equally on the beneficial ones that prey upon them. The remote position of the islands, and the consequently limited fauna, giving free scope for increase to new arrivals, the general absence of creatures injurious to the introduced beneficial species, and the equability of the climate, allowing of almost continual breeding, may well afford results which could hardly be attained elsewhere on the globe. The keen struggle for existence of continental lands is comparatively non-existent, and, so far as it exists, is rather brought about by the introduced fauna than by the native one."

Mr. Perkins' reasons are all good, but he has not mentioned one prime reason of success, and that is that the most successful of the imported species have come from another portion of the same great faunal region, while others have been received from the region most closely allied, viz., the Oriental.

Wallace took the view that the effectual migration of insects is, perhaps, more than with any other class of animals, limited by organic and physical conditions. "The vegetation," he says, "the soil, the temperature and the supply of moisture must all be suited to their habits and economy, while they require an immunity from enemies of various kinds, which immigrants to a new country seldom obtain."

There is much truth in this statement, but it must be remarked that, in practical experience, immunity from enemies of various kinds is what insect immigrants find, not what they leave behind them. It takes some time before they weave into a new chain of organism preying upon organism. Our insect importations from abroad, when they are of economic importance—and those from Europe are very likely to be of such importance—leave their old insect enemies behind them and frequently are not readily attacked by native ones. These last accommodate themselves to the new comer in time, but for a while he enjoys comparative immunity. The rapid multiplication and spread of Pieris rapæ, of Hemiotobia serrata, of Phytonomus punctatus, of Porthetria dispar, of Anthonomus grandis, of Icerya purchasi and many others may probably be principally laid to this cause.

I should be remiss did I not refer to another aspect of the accidental introduction of species, viz., that it not only adds species to a native fauna, but also that it often causes the disappearance of native forms. Since the establishment, within our boundaries, of Pieris rapæ, our native Pontia oleracea has almost entirely disappeared in localities in which it formerly abounded, and in some sections has entirely disappeared. Since Doryphora 10-lineata came east and multiplied upon the cultivated potato in such prodigious numbers, the formerly common eastern Doryphora juncta has become a rare species. Walsh pointed out thirty years ago that one effect of the westward spread of the European Mytilaspis pomorum was to cause the gradual local disappearance of the native Chionaspis furfurus. Hubbard has shown that the increase of the imported Mytilaspis citricola in Florida was followed by the decrease of Mytilaspis gloverii, which, though not native, was an earlier importation—a most interesting, and, so far as records go, unique case. Instances might be multiplied which will show that the establishment of foreign species thus often produces at least a dual effect on the character of the fauna as a whole.

In closing it will not be inappropriate to point out that the accidental importation of species is only one of the ways in which the agency of man is altering the character of native faunas, and, that, in spite of its extent, it is really the least of the ways. The influence of civilization is immediately destructive to natural floras and faunas. It is already too late to gain an adequate idea of natural conditions in even recently settled portions of the globe. Wallace has dwelt upon the comparatively scanty and unimportant results to natural history of most of the great scientific voyages of the various civilized governments during the present century, from which it has resulted that "the productions of some of the most frequently visited and most interesting islands on the globe are still very imperfectly known, while their native plants and animals are being yearly exterminated. . . . Such are the Sandwich Islands, Tahiti, the Marquesas, the Philippine Islands and a host of smaller ones; while Bourbon and Mauritius, St. Helena and several others have only been adequately explored after an important portion of their productions has been destroyed by cultivation or the reckless introduction of goats and pigs." ("Island Life," p. 7.)

Elsewhere he shows that the introduction of goats into St. Helena utterly destroyed a whole flora of forest trees, and with them all the insects, mollusca, and perhaps birds dependent upon them. And further, that "cattle will in many districts wholly prevent the growth of trees; and with the trees the numerous insects dependent on those trees, and the birds which

* Paper read before the Zoological Section of the American Association for the Advancement of Science, August, 1897. A portrait of Doctor Howard will be found in the SCIENTIFIC AMERICAN of September 25, page 193.

† During the later months of the World's Fair precautionary measures were instituted under Mr. Chittenden's supervision. Much dry food material was fumigated with bisulphide of carbon, and many samples which were very badly infested were burned. At least four new and dangerous species of insects were destroyed in this way.

feed upon the insects, must disappear as well as the small mammalia which feed on the fruits, seeds, leaves or roots." Many local American instances have been brought together by Mr. F. M. Webster in an important paper entitled "Biological Effects of Civilization on the Insect Fauna of Ohio," which comes to me as I write these closing lines.

But the purpose of this address has been to dwell solely upon the question of the spread of species, and I must not touch upon other topics, however closely akin. It seems to me that the practical point to which we must come, after summarizing all that has been shown, is that since so many species have been imported by pure accident, and have succeeded perfectly in becoming acclimatized, may not much be accomplished by wisely planned and carefully guarded introductions? The somewhat haphazard but none the less important and skillful work of Albert Koebele, first for the United States government, afterward for the State of California, and now for the Hawaiian government, is certainly an indication, taken in connection with what we have shown, that thorough experimental work with predaceous and parasitic insects promises, in especial cases, results of possibly very great value.

We wish no more destructive birds like the English sparrow, we have no desire to make an American resident of the Indian mongoos, nor have we any desire to import the Australian flying fox as a pet. Neither do we desire to allow any more European plants to escape from cultivation and emulate the Russian thistle. But there are many absolutely beneficial insects of Palearctic regions which might flourish among us, and whose intentional introduction could not be harmful from any point of view, while they might be of the greatest service.

[Continued from SUPPLEMENT, No. 1135, page 18148.]

THE BRITISH ASSOCIATION—ADDRESS IN ANTHROPOLOGY.

THE address in Section H was delivered by Prof. Sir W. Turner, D.Sc., F.R.S. L. and E., who selected as the subject:

SOME DISTINCTIVE CHARACTERS OF HUMAN STRUCTURE.

THE EFFECT OF CLOTHES.

One of the requirements of civilization is the wearing of clothes, and fashion frequently prescribes that they should be tight-fitting and calculated to restrict motion in and about the spinal column. In savage races, on the other hand, clothing is often reduced to a minimum, and when worn is so loose and easy as in no way to hamper the movements of the body. The spinal column retains, therefore, in them much more flexibility, and permits the greater measure of freedom in the movements of the trunk which is found in savage man, and has often been referred to by travelers. It used to be considered that the possession of a lumbar convexity in the spinal column was the exclusive privilege of man, and was shared in by no other vertebrate. There can be no doubt that it attains a marked development in the human spine, and, as such, is associated with the erect posture. But the observations of Cunningham on the spinal column of apes, more especially the anthropoid group, made in fresh specimens, in which the intervertebral disks were in place, have proved that in the chimpanzee the lumbar convexity is probably as strongly pronounced as in the adult man. In a chimpanzee, two years old, the development is more advanced than in a child of the same age. The lumbar convexity is established at an earlier age than in the child, for it would seem as if the chimpanzee attained its maturity at a younger period of life than the human being. In the orang the lumbar curve is more feeble than in man and the chimpanzee, and in the specimen described by Cunningham resembled that of a boy six years old. In a fresh specimen of the gibbon, examined by the same anatomist, the lumbar curve was intermediate between the chimpanzee and the orang. Without going into the question whether a lumbar convexity exists in the tailed monkeys, the determination of which with precision is a matter of some difficulty, it must be obvious that the presence of this convexity can no longer be regarded as the exclusive prerogative of man. It undoubtedly forms an important factor in the study of the erect attitude; but in order that man should acquire and be able to retain his distinctive posture, something more is necessary than the possession of a spinal column with a curve in the lumbar region convex forward.

THE THIGH AND LEG.

Our attention should now be directed to the lower limbs, more especially to the two segments of the shaft, which we call thigh and leg. If we look at a quadruped, we see that the thigh is bent on the trunk at the hip joint, and that the leg is bent on the thigh at the knee joint; while the foot forms more or less of an angle with the leg, and the animal walks either on the soles of its feet or on its toes. In the anthropoid apes there is also distinct flexure both of the hip and knee joints, so that the leg and thigh are set at an angle to each other, and the foot is modified, through a special development of the great toe, into an organ of prehension as well as of support. When we turn to the human body, we find that in standing erect the leg and thigh are not set at an angle to each other, but that the leg is in line with and immediately below the thigh, that both hip and knee joints are fully extended, so that the axis of the shaft of the lower limb is practically continuous with the axis of the spine. The foot is set at right angles to the leg, and the sole is in relation to the ground. The vertical axis of the shaft of the lower limb, the extended condition of the hip and knee joints, and the rectangular position of the foot to the leg are, therefore, fundamental to the attainment of the erect attitude of man. As compared with the ape, the shaft of the human thigh bone is not so broad in relation to its length; when standing erect the shaft is somewhat more oblique, it is more convex forward and generally more finely molded, and it has three almost equal surfaces, the anterior of which is convex. But, further, a strong ridge (linea aspera) extends vertically down its posterior surface, so that a section through the shaft is triangular, with the two anterior angles rounded and the posterior prominent. In the gorilla, chimpanzee, and orang the shaft is flattened from before backward, and the linea aspera is represented by two faint lines, separated from each other by an intermediate narrow area. A section through the shaft approximates to an ellipse. In the gibbon the femur is greatly elongated, and the shaft is smooth and cylindriform. The linea aspera is for the attachment of powerful muscles, which are more closely aggregated in man than in apes, so that the human thigh possesses more graceful contours. In the human femur the shaft is separated from the neck by a strong anterior intertrochanteric ridge, to which is attached the ilio-femoral ligament of the hip joint, which by its strength and tension plays so important a part in keeping the joint extended when the body is erect. In the anthropoid apes this ridge is faint in the gorilla, and scarcely recognizable in the orang, gibbon, and chimpanzee, and the ilio-femoral ligament in them is comparatively feeble.

It may safely, therefore, be inferred that in apes, with their semierect crouching attitude, the ilio-femoral band is not subjected to, or capable of sustaining, the same strain as in man. The head of the thigh bone is also distinctive. In the apes the surface covered by cartilage is approximately a sphere, and is considerably more than a hemisphere. It is sharply differentiated from the neck by a definite boundary, and it has a mushroomlike shape. In man the major part of the head is also approximately a sphere; but, in addition, there is an extension outward of the articular area on the anterior surface and upper border of the neck of the bone. The form of this extended area differs from the spherical shape of the head in general. The curvature of a normal section of its surface has a much larger radius than the curvature of a normal section of the head, near the attachment of the ligamentum teres.

THE HUMAN FOOT.

I shall now proceed to the examination of the human foot (pes), and in order to bring out more clearly its primary use as an organ of support and progression, I shall contrast it with the human hand (manus) and with the manus and pes in apes. In man, while standing erect, the arched sole of the foot is directed to the ground, and rests behind on the heel and in front on pads, placed below and in line with the metatarso-phalangeal joints, the most important of which is below the joint associated with the great toe. It is, therefore, a plantigrade foot. The great toe (hallux) lies parallel to the other toes, and from its size and restricted movements gives stability to the foot. The ape's foot agrees with that of man in possessing similar bones and almost similar soft parts; but it differs materially as to the uses to which it can be put. Some apes can undoubtedly place the sole upon the ground, and in this position use the foot both for support and progression, though the orang, and to some extent other anthropoid apes, rest frequently upon the outer edge of the foot. But, in addition, these animals can use the foot as a prehensile organ like the hand. The old anatomist, Tyson, in his description of a young chimpanzee, spoke of the pes as "liker a hand than a foot" and introduced the term "quadrumanous," four-handed, to designate this character. This term was adopted by Cuvier, and applied by him to apes generally, and has long been in popular use. The eminent French anatomist was, however, quite alive to the fact that, though the pes was capable of being used as a hand, yet it was morphologically a foot, so that the term was employed by him to express a physiological character. In the ape the great toe, instead of being parallel to the other toes as in man, is set at an angle to them, not unlike the relation which the thumb (pollex) bears to the fingers in the human hand. It is able, therefore, to throw the hallux across the surface of the sole in the prehensile movement of opposition, as it can at the same time bend the other toes toward the sole. It also has the power of encircling an object more or less completely with them. By the joint action of all the toes a powerful grasping organ is produced, more important even than its hand, in which the thumb is feebly developed. It has sometimes been assumed that the human foot is also a prehensile instrument as well as an organ of support. In a limited sense objects can undoubtedly be grasped by the human toes when bent toward the sole. In savages this power is preserved to an extent which is not possible in civilized man, in whom, owing to the cramping, and only too frequently the distorting influence, exercised by badly-fitting boots and shoes, the proper development of the functional uses of the toes is impeded, and their power of independent movement is often destroyed. If we compare the anatomical structure of the human foot with that of the foot of the ape, though the bones, joints, and muscles are essentially the same in both, important differences in arrangement may be easily recognized, the value of which will be better appreciated by first glancing at the thumb. Both in man and apes the thumb is not tied to the index digit by an intermediate ligament, which, under the name of "transverse metacarpal," binds all the fingers together, and restricts their separation from each other in the transverse plane of the hand. The great toe of the ape, similarly, is not tied to the second toe by a "transverse metatarsal ligament," such as connects together and restricts the movements of its four outer toes in the transverse plane of the foot. The hallux of the ape is, therefore, set free. It can, like the thumb of man and ape, be thrown into the position of opposition and be used as a prehensile digit. Very different is the case in the human foot, in which the hallux is tied to the second toe by a continuation of the same transverse metatarsal ligament which ties the smaller toes together. Hence it is impossible to oppose the great toe to the surface of the sole in the way in which the thumb can be used, and the movements of the digit in the transverse plane of the foot are also greatly restricted.

THE HEAD.

The head, situated at the summit of the spine, holds a commanding position. Owing to the joints for articulation with the atlas vertebra being placed on the under surface of the skull, and not at the back of the head, and to the great reduction in the size of the jaws, as compared with apes and quadrupeds generally, the head is balanced on the top of the spine. The ligaments supporting it and connected with it are comparatively feeble, and do not require for their attachment strong, bony ridges on the skull, or massive projecting processes in the spine, such as one finds in apes and many other mammals. The head with the atlas vertebra can be rotated about the axis vertebra by appropriate muscles. The face looks to the front, the axis of vision is horizontal, and the eye sweeps the horizon with comparatively slight muscular effort. The cranial cavity, with its contained brain, is of absolutely greater volume in man than in any other vertebrate, except in the elephant and in the large whales, in which the huge mass of the body demands the great sensory-motor centers in the brain to be of large size. Relatively also to the mass and weight of the body, the brain in man may be said to be in general heavier than the brains of the lower vertebrates, though it has been stated that some small birds and mammals are exceptions to this rule. We have abundant evidence of the weight of the brain in Europeans, in whom several thousand brains have been tested. In the men, the average brain weight is from 49 to 50 oz. (1,390 to 1,418 grm.) In the women, from 44 to 45 oz. (1,248 to 1,283 grm.) The difference in weight is doubtless in part correlated with differences in the mass, weight and stature of the body in the two sexes, although it seems questionable if the entire difference is capable of this explanation. It is interesting to note that even in new born children the boys have bigger heads and heavier brains than the girls. Dr. Boyd gives the average for the girl infants as 10 oz. and for boys 11·67 oz. A distinction in the brain weight of the two sexes is obviously established, therefore, before the child is born, and is not to be accounted for by the training and educational advantages enjoyed by the male sex being superior to those of the female sex. The brains of a number of men of ability and intellectual distinction have been weighed, and ascertained to be from 55 to 60 oz. In a few exceptional cases, as in the brains of Cuvier and Dr Abercrombie, the weight has been more than 60 oz.; but it should also be stated that brains weighing 60 oz. and upward have occasionally been obtained from persons who had shown no sign of intellectual eminence.

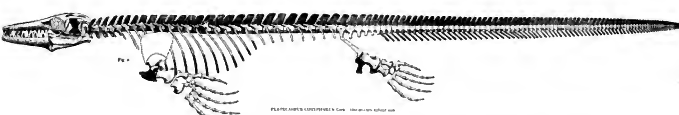
PHRENOLOGY.

The school of phrenologists represented in the first half of the century by Gall, Spurzheim, and George Combe, while recognizing the importance of the size of the brain as a measure of intellectual activity, also attached value to what was called its quality. At that time the inner mechanism of the brain was almost unknown, for the methods had not been discovered by which its minute structure could be determined. It is true that a difference was acknowledged between the cortical gray matter situated on the surface of the hemispheres and the subjacent white matter. Spurzheim had also succeeded in determining the presence of fibers in the white matter of the encephalon, and had, to a slight extent, traced their path. The difference between the smooth surface of the hemispheres of the lower mammals and the convoluted surface of the brain of man and the higher mammals, and the influence which the development of the convolutions exercised in increasing the area of the cortical gray matter, were also known. A most important step in advance was made when, through the investigations of Leuret and Gratiolet, it became clear that the convolutions of the cerebrum, in their mode of arrangement, were not uniform in the orders of mammals which possessed convoluted brains, but that different patterns existed in the orders examined. By his further researches, Gratiolet determined that in the anthropoid apes, notwithstanding their much smaller brains, the same general plan of arrangement existed as in man, though differences occurred in many of the details, and that the key to unlock the complex arrangements in man was to be obtained by the study of the simpler disposition in the apes. These researches have enabled anatomists to localize the convolutions and the fissures which separate them from each other, and to apply to them precise descriptive terms. These investigations were necessarily preliminary to the histological study of the convolutions and to experimental inquiry into their functions. By the employment of the refined histological methods now in use, it has been shown that the gray matter in the cortex of the hemispheres, and in other parts of the brain, is the seat of enormous numbers of nerve cells, and that those in the cortex, while possessing a characteristic pyramidal shape, present many variations in size. Further, that these nerve cells give origin to nerve axial fibers, through which areas in the cortex become connected directly or indirectly, either with other areas in the same hemisphere, with parts of the brain and spinal cord situated below the cerebrum, with the muscular system, or with the skin and other organs of sense. Every nerve cell, with the nerve axial fiber arising from and belonging to it, is now called a neurone, and both brain and spinal cord are built up of tens of thousands of such neurones. It may reasonably be assumed that the larger the brain, the more numerous are the neurones which enter into its constitution. The greater the number of neurones, and the more complete the connections which the several areas have with each other through their axial fibers, the more complex becomes the internal mechanism, and the more perfect the structure of the organ. We may reasonably assume that this perfection of structure finds its highest manifestations in the brain of civilized men. The specialization of the relations and connections of the axial fiber processes of the neurones, at their termination in particular localities, obviously points to functional differences in the cortical and other areas, to which these processes extend. It has now been experimentally demonstrated that the cortex of the cerebrum is not, as M. Flourens conceived, of the same physiological value throughout; but that particular functions are localized in definite areas and convolutions. It speaking of localization of function in the cerebrum, one must not be understood as adopting the theory of Gall, that the mental faculties were definite in their number, that each had its seat in a particular region of the cortex, and that the locus of this region was marked on the surface of the skull and head by a more or less prominent "bump." We have now direct anatomical evidence, based upon differences in the stages of development, that, in addition to the sensory and motor areas in the cortex of the human brain, a third division—the association centers—is to be distinguished. If we compare the cerebrum in man and the apes, we find those convolutions which constitute the motor and sensory centers distinctly marked in both. An ape, like a man, can see, hear, taste, smell, and touch; it also exhibits great muscular activity and variety of movement. It possesses, therefore, similar fundamental centers of

sensation motion, which are situated in areas of the cortex resembling in arrangement and relative position though much smaller in size than the corresponding convolutions in the adult human brain. It is not unlikely, though the subject needs additional research, that the miniature structure of these centers resembles that of man, though, from the comparatively restricted area of gray matter in the ape, the neurones will necessarily be much fewer in number. In the cerebrum of a new born infant, while the motor and sensory convolutions are distinct, the convolutions for the association areas, though present, are comparatively simple, and do not possess as many windings as are to be seen in the brain of a chimpanzee not more than three or four years old. The problem which has now to be solved is the determination of their function. Prolonged investigation into the development and comparative histology of the brain will be necessary before we can reach a sound anatomical basis on which to found satisfactory conclusions.

INSTINCT AND INTELLIGENCE.

We know that an animal is guided by its instincts, through which it provides for its wants and fulfills its place in nature. In man, on the other hand, the instinctive acts are under the influences of the reason and intelligence, and it is possible that the association centers, with the intermediate association fibers which connect them with the sensory and motor centers, may be the mechanism through which man is enabled to control his animal instincts, so far as they are dependent on motion and sensation. The higher we ascend in the scale of humanity, the more perfect does this control become, and the more do the instincts, emotions, passions and appetites become subordinated to the self-conscious principle which regulates our judgments and beliefs. It will, therefore, now be a matter for scientific inquiry to determine, as far as the anatomical conditions will permit, the proportion which the association centers bear to the other centers both in mammals and in man, the period of development of the association fibers, in comparison with that of the motor and sensory fibers in different animals, and, if possible, to obtain a comparison in these respects between the brains of savages and those of men of a high order of intelligence. The capability of erecting the trunk; the power of extending and fixing the hip and knee joints when standing; the stability of the foot; the range and variety of movement of the joints of the upper limb; the balancing of the head on the summit of the spine; the mass and weight of the brain, and the perfection of its internal mechanism, are distinctively human characters. They are the factors concerned in adapting the body of man, under the guidance of reason, intelligence, the sense of responsibility and power of self-control, for the discharge of varied and important duties in relation to himself, his Maker, his fellows, the animal world, and the earth on which he lives.



RESTORATION OF KANSAS MOSASAURS.

RESTORATION OF KANSAS MOSASAURS.

By S. W. Williston.

In the present communication are given restorations of the three principal genera of Kansas Mosasaurs, based upon the material now in the University of Kansas Museum. A detailed description of this material is now in preparation to be shortly published as a volume of the University Geological Survey, of which Chancellor Snow is director. At present only the more striking characters of the three forms will be discussed.

The three genera herewith given comprise all the authentic types known from Kansas. In addition, Holosaurus Marsh, Sironectes Cope and Baptosaurus Marsh have been described from or accredited to the Cretaceous of the State. Sironectes is, I believe, a synonym of Platecarpus. It was based upon the presence of the zygosphene in connection with free chevrons. In Platecarpus there is, in most species, a rudimentary zygosphene, and in some it is nearly as large as in some species of Clidastes. It is possible that Holosaurus is a good genus, but specimens of it must be exceedingly rare. The type specimen, now in the Yale Museum, was collected by myself and represents nearly the complete skeleton. Baptosaurus is practically known only from the posterior part of the jaw, described by Merriam. This is very peculiar in having the articular bone reflected upward at the extremity.

The material upon which the restorations here given are based is as follows: Clidastes is restored from a single specimen, complete in all details, save the terminal phalanges of the front paddle and most of those of the hind paddles. The present restoration differs from the one previously published only in the less flattened skull and in the curvature of the digits.

Platecarpus is based chiefly upon one specimen, comprising a nearly complete disarticulated skull and a connected series of vertebræ to beyond the middle of the tail, the sixty-fifth, together with the pectoral and pelvic girdles and most of the bones of the limbs. The arrangement of these bones has been copied, from Marsh, with some changes. The only parts conjectural are the number of long ribs and the number of chevron-caudal vertebræ. Isolated bones and partly connected series of caudal vertebræ are preserved in other specimens, from which there seem to be very slight differences from the corresponding parts of Tylosaurus. The tail has, therefore, been made to correspond with that of Tylosaurus in length.

Tylosaurus is drawn from three specimens, one with the posterior part of the head and the vertebral column complete to the tip, the second with the skull and cervical vertebræ in perfect preservation, the third with the paddles nearly complete, together with the larger part of the vertebræ and ribs. This last specimen is the one of which figures of the paddles and skin were given by me in a recent issue of this journal. All of these specimens agree closely in size and characters, clearly belonging to the same species.

A comparison of these genera, as shown by the restorations, will be of interest. Platecarpus has an intermediate position between Clidastes and Tylosaurus, which represent the extremes of development of the Kansas forms. In Clidastes the thorax is elongate, the tail relatively short and modified into a powerful propelling organ. The limbs are small, the hind ones especially so. The animal throughout is more slender, and the head relatively short, agreeing in this respect more closely with their nearest modern relatives, the species of Varanus. The vertebræ have the firmest and closest articulations, with the interlocking zygosphene best developed of any of the Mosasaurs. The limbs are less flexible, but relatively stronger, as shown by the closely articulating bones and the fully developed carpus and tarsus, and the more pronounced processes for muscular attachment. The movement through the water in this form was more snakelike than in the others, and propulsion was largely by means of the tail.

In Platecarpus we have the same shortened muzzle as in Clidastes, the vertebræ also relatively slender, and the zygosphene imperfectly developed. The paddles are more of the Clidastes type than that of the Tylosaurus, though the carpus and tarsus are less well developed than in the former. The hind paddles are only slightly smaller than the fore ones, and all are powerful propelling organs, far more so than in any other known genus of the group. Altogether, in proportion to its size, Platecarpus was the most powerful and predaceous of the Kansas Mosasaurs. It will be observed that the teeth in this form, while not as numerous as in Clidastes, or as stout as in Tylosaurus, are more effective weapons than in either of these genera, being more elongated, more curved and more pointed. The neural spines do not form as close a series as in Tylosaurus, indicating greater flexibility.

In Tylosaurus we have in some respects the most specialized of the Mosasaurs. The almost wholly cartilaginous carpus and tarsus, the more elongated digits and the greater number of the phalanges are characters brought about by aquatic habits. On the other hand, the hind paddle is actually larger than the front, and the fifth digit has undergone little or no reduction—characters of a more primitive rank. The paddles are more flexible than in either of the other genera, but they are relatively small and not at all strong. The skull is more elongated anteriorly and there is no trace of a zygosphene.

Dr. Dollo has expressed a doubt of the nature of the vertebræ called pygial by Mr. Case and myself in a former publication. He believes that some of them at least are true lumbar vertebræ, as all were previously thought to be. I feel yet more assured that they are basal caudal and have so restored the different genera. In the living lizard, with the sacral synchondrosis, the ilium is directed forward, throwing the symphysis ischii below the sacrum and leaving the outlet of the pelvis unrestricted. In Varanus there are as few as two non-chevron-bearing vertebræ back of the sacrum. More were not needed. In these marine lizards, on the other hand, the shaft of the ilium is directed obliquely forward, bringing the symphysis of the ischii below the fourth or fifth of the vertebræ succeeding the ligamentous attachment. If these or any of them bore chevrons, it will be immediately seen that they would project into the cavity of the pelvis. Not less than six pygal vertebræ are necessary to leave space for the free exit of the cloaca. The ilium must have been in every case attached to the first non-costiferous vertebra.

In these three species the number of vertebræ in the different regions may be given as follows:

	Clidastes.	Platecarpus.	Tylosaurus.
Cervical	7	7	7
Thoracic	11	13?	13?
Lumbodorsal	24	9	10
Pygal caudals	7	5	6
Diapophysial caudals	25	15	25
Non-diapophysial caudals	45	?	55

The zygapophyses in all three forms terminate at or near the end of the rib-bearing vertebræ. In the cervical region they are strong, diminishing but little in size through the thoracic region. In the region which I call lumbodorsal they become weaker. The vertebræ increase in length through the thoracic region, but diminish very rapidly in length at the end of the costiferous series.

The length of Clidastes velox is about twelve feet, that of Platecarpus coryphæus nearly fourteen, while Tylosaurus proriger, one of the smaller species of the genus, was over twenty-three feet. The smallest species of Clidastes, C. pumilus, if it be a distinct species, was about six feet in life. The largest species of the Kansas Mosasaurs, Tylosaurus dyspelor, had a length of nearly thirty feet. Only one other species of the group larger than Tylosaurus dyspelor has been described from America—Mosasaurus maximus Marsh, from New Jersey. If it had the same proportions as Tylosaurus, its length would be about thirty-two feet. If like Clidastes, as it was in all probability, its length would not exceed thirty-six feet. European forms somewhat larger than this have been described, possibly reaching a length of nearly forty feet. The text-books and popular descriptions place the length of these animals at from seventy five to one hundred feet.

The food of the Mosasaurs must have consisted chiefly of fishes of moderate size, with occasional victims of their own kind. While the flexibility and loose union of the jaws undoubtedly permitted animals of considerable size to be swallowed, the structure of the thoracic girdle would not have permitted any such feats of deglutition as the python and boa are capable of. The animals must have been practically helpless on land. They were not sufficiently serpentine to move about without the aid of the limbs, and these were not at all fitted for land locomotion. They lived in the open sea, often remote from the shores. Their pugnacity is amply indicated by the many scars and injuries they received, probably from others of their own kind.—Kansas University Quarterly.

MUMMIED HEADS.

HEREWITH are presented four cuts of very strange, post-mortem, artificially contracted Indian heads from Ecuador and Brazil. All have had the bones removed and are mummied to about the size of a large orange; are of slightly aromatic odor and leathery consistency.

The origin of these is somewhat mysterious. They are decidedly scarce, the few that have found their way into museums having for the most part been obtained in or about the town of Macas, at the foot of the

FIG. 1.

Andes—a town which does not at present have any direct intercourse with whites. Those from Macas appear to be larger than the few that have been derived direct from the Indians of the Jivaro tribe.

In the London Intellectual Observer of 1862 Bollaert, who draws his information from a history given by Velasco, says: "Heads of victims are cut off, the skull and its contents removed, and a heated stone introduced into the hollow of the skin. Desiccation goes on and it is reduced to about one-fourth, retaining some few of the features. . . . A double string is attached to the top of the head, so that it may be worn around the neck. The lips are sewn together and a number of strings hung from them, the use of which is not apparent."

In the Journal of the Anthropological Institute for 1874 Sir John Lubbock made the declaration—though upon what authority is not known—that "these heads are boiled for some time in an infusion of herbs, the bones then removed from the neck and heated stones put into the hollow, whereby the head is dried and contracted."

Dr. Page in a recent paper* states, on the strength

FIG. 2.

of "a distinguished anatomical authority in England," that if a dried preserved head be softened, boiled in water, and the bones removed by means of an incision along the occiput, the soft parts will shrink in exactly the same manner as the preserved Indian heads.

The same gentleman gives a list of such heads as he has been able to trace in the different museums of Europe. Besides six that were variously exhibited in London between 1853 and 1882, there are four in the British Museum; one in Brighton Museum; one at Owens' College, Manchester; three at Cambridge University; one in the Antiquarian Museum, Edinburgh; one in the Edinburgh University Anatomical Museum; one in Dublin University; three in Berlin University; three in the Public Museum of Vienna; three in the Vienna Pathological Museum. The editor of this journal has seen no less than four within the limits of the United States and one in Canada, all in private hands, though it is understood one of these has been donated to the Smithsonian Institution. Some of the heads described by Page do not, however, properly belong to this category, as they are of materially larger size, many containing a considerable proportion of the bony constituents, and the majority lack the thread ornaments which are the characteristics of those obtained from the Jivaros. It must be understood at once that the preserved heads from the East Indies, such as

FIG. 3.

are found among the Dyaks of Borneo and Sumatra, and likewise those derived from the Manchurucus of Brazil, are of entirely different character from these herein illustrated, and in great part retain their natural size.

Besides the list given by Page, we are informed there are several in Italian museums—four or five—and three at Madrid; there was also one—that probably pertains to the list given by Dr. Page—in possession of the late Dr. Frank Buckland, a facsimile of which appears in Fig. 1.

Of those brought to the United States, four were originally in the possession of Mr. Hassaurek, formerly United States minister to Ecuador, which the writer had the privilege of examining some years since. Mr. Hassaurek is authority for the information that these are not "worn about the neck," neither are they, as has been generally surmised, worshiped as household gods, but obtained by the Jivaros from the huacas or ancient burial places. While they are regarded with considerable reverence, no such superstition attaches thereto as has been commonly credited. It was a Dr. Andrade, curate of the village of Machuchi, who first propounded the idea that these heads were treated as idols, especially implored to keep family secrets, and for every secret intrusted a string drawn through the lips; he is to be credited also with promulgating the belief that they are worn by their possessors on solemn occasions as ornaments. All this is purely hypothetical, without any true foundation.

FIG. 4.

None of the heads seen by us have ever been opened upon the occiput, and only in one or two instances was there a cord through the sinciput for purposes of suspension.

It would seem highly probable that the threads that passed through the lips originally possessed some such significance as the Quippus of the ancient Peruvians, which are said to have been composed of large base cords, to which were fastened in a peculiar manner threads more or less fine and knotted or entwined in established order for the purpose of expressing ideas, events or numbers. The ancient Peruvians were in the habit of carving in semblance of human form the posts or wooden "idols" (?) which held these registers. The art or science of the Quippu language appears to have been lost to a great extent by modern Peruvians, although it is imagined there are in the southern provinces Indians who understand how to decipher these intricate memorials, but guard their knowledge religiously as a sacred secret inherited from their ancestors.

The configuration of the lips of these mummied heads, the perforations through them—which no doubt date from the earliest history of mummification—strongly suggests a purpose of chronicling history. Something of the same kind was observed of certain of the mummies that have been found of an extinct race that formerly inhabited the Fortunate (Canary) Islands.—The Medical Age.

* Journal of Anatomy and Physiology, January, 1897.

ASTRONOMICAL WORK AT LICK OBSERVATORY.

By EDWARD S. HOLDEN, Director of Lick Observatory.

WHILE the resources of the Lick Observatory are large in comparison with those of many college observatories, they are very small in relation to those of the great establishments of Greenwich, Paris, Pulkova, Washington and Harvard College. For instance, the whole available income of the Lick Observatory for the coming fiscal year (exclusive of salaries) is $5,145. This sum must keep all the buildings painted and in repair; keep all our reservoirs and some five miles of underground pipes in order; provide for all painting, plumbing, brick laying, pipe fitting, carpenter work, machine work, etc., in the observatory and in the houses of astronomers and workmen; buy all supplies, such as lumber, hay, iron, brick, etc.; pay for all instrument making not done in the observatory; pay all freight, express and telegraph bills, maintain a telephone line 17 miles long in good order; pay for fuel, purchase books for the library; provide any needed apparatus for all the instruments, and, this year, buy much of the material needed for an eclipse expedition to India. It is no small task to make the small income cover the requirements. Every want which is felt in a large city is felt here. The circumstances at Mount Hamilton are as different as possible from those at Eastern observatories. There each person must provide for his own personal comfort; here the comfort of each one must be secured by the expenditure of the annual appropriation. If it is insufficient, every person suffers in some degree.

The astronomical efficiency of the Lick Observatory cannot be properly estimated without taking such material and social considerations into account. Under the circumstances, I do not think it is too much to claim that its efficiency during the nine years of its life has been satisfactory. This has only been attained by good will and earnest effort on the part of all concerned—regents, astronomers, mechanics, workmen. The summary of work for which you asked is given below.

Double stars have been measured here in past years in great numbers by Prof. Burnham, and at the present time Profs. Schaeberle, Hussey and Aitken are engaged in such work for parts of their time.

The satellites of Mars, Jupiter, Uranus and Neptune have been regularly observed here for the past nine years by Messrs. Schaeberle, Barnard, Campbell and Hussey. A fifth satellite of Jupiter was discovered by Prof. Barnard in 1892.

The planets, especially Mars, Jupiter, Saturn (and also Venus and Uranus), have been systematically observed for their physical features at every opposition by Messrs. Holden, Schaeberle, Keeler, Barnard and Hussey. For several oppositions of Mars the planet has been followed by Messrs. Holden, Schaeberle and Campbell during every available hour.

Comets have been discovered here in great numbers. Ten comets (seven unexpected) were discovered by Prof. Barnard from 1888 to 1892; five (four unexpected) by Mr. Perrine from 1895 to date. The long series of observations of these and other comets by Messrs. Barnard, Campbell, Hussey, Perrine and Aitken are a contribution to science even more important than the discoveries themselves.

Comet orbits have been computed here by Messrs. Schaeberle, Campbell, Hussey, Perrine and Aitken; and all comets discovered at the observatory have had their first orbits calculated by officers of the university. In this work Prof. Leuschner, of Berkeley, a former student here, and his assistant, Mr. F. H. Seares, have rendered assistance which is much appreciated.

Meteors have been observed and photographed here (and elsewhere) by all the astronomers, and their orbits calculated by Messrs. Holden and Schaeberle.

Double star orbits have also been computed by Prof. Schaeberle.

The zodiacal light was regularly observed (visually) by Prof. Barnard.

The aurora has been regularly observed (spectroscopically) by Prof. Campbell.

Typical or remarkable cloud forms are regularly photographed by Mr. Pauli, janitor of the observatory.

Nebulæ have been observed (visually, photographically and spectroscopically) by Messrs. Holden, Burnham, Schaeberle, Barnard and Campbell.

Star maps have been made and published by Mr. Tucker.

Photometry (photographic and visual)—of eclipses and of stars—has been attended to by Messrs. Holden, Schaeberle, Campbell and Leuschner.

Solar Eclipses.—Those of January and December, 1889, April, 1893, August, 1896, have been observed by Messrs. Burnham, Schaeberle, Keeler, Barnard, Leuschner and Campbell, and the latter will observe the eclipse of January, 1898, in India.

Lunar Eclipses.—All lunar eclipses visible here have been observed.

Occultations.—A series of occultations has been observed here by Prof. Leuschner.

Transits of Mercury.—Three transits of Mercury have been observed, either visually or photographically.

Transit of Venus.—That of 1882 was successfully photographed here by Prof. Todd.

Catalogues of Stars.—Two such are in progress of preparation.

1. A catalogue of double stars and of coast survey stars from observations by Prof. Schaeberle has been (partly) reduced, on lines laid down by myself, by Messrs. Schaeberle, Campbell, Leuschner, Aitken and Prof. Bigelow and Mrs. Updegraff. Prof. Aitken has spent more than a year on this work.

2. A catalogue of 28,000 stars from Washington observations is well toward completion. The reductions have been made chiefly by Messrs. Holden and Aitken. The original observations as printed were full of errors. The final places will be considerably more precise in declination and somewhat less precise in right ascension than the southern zones of Argelander.

Solar Photography.—Some 1,930 negatives of the sun (taken with the photoheliograph) have been secured by Mr. Perrine, and since April, 1896, some 450 more by Mr. Colton. Excellent experimental solar photographs on a large scale have been made with the 36 in. telescope, and it is hoped to go very much further with this work during the summer of 1897.

Lunar Photography.—A very full series of focal negatives has been made with the 36 inch telescope, chiefly by Messrs. Holden and Colton. An atlas on the scale of X feet to the moon's diameter has been prepared from these by Prof. Weinek, at Prague. Enlargements in the telescope have been made by Messrs. Holden, Colton and Perrine, and 5 plates of a moon atlas on the scale of 111 feet to the moon's diameter have been distributed. Twelve more plates are now in the hands of the engraver and will soon be issued; and about 20 more are ready to be published when the funds are available. The atlas will be complete with about 60 plates. All the work in the dark room was done by Mr. Colton.

Photographs of the Milky Way.—A great number of such pictures has been obtained by Prof. Barnard, who is preparing them for publication.

Photographs of planets, especially of Jupiter, have been regularly made by Messrs. Holden, Schaeberle and Colton.

Photographs of comets have been secured by Messrs. Barnard, Hussey and Colton.

Visual Photometry.—Two fine photometers of Prof. Pickering's design have lately been given to us by Miss Bruce. They will be used by Prof. Aitken, chiefly on double stars at present.

Spectroscopic observations of nebulæ, new stars, comets, stars and planets, have been made by Messrs. Keeler and Campbell. The chief problem of the great telescope is to determine the motion of the solar system by spectroscopic observations. It was first attacked here in 1888, and since that time it has been considered as our most important work. The results now attained by Prof. Campbell are of unexampled precision, and some of them will be published shortly. Many unexpected delays have occurred in this research, which has been under the charge of Messrs. Keeler, Crew and Campbell.

Time signals are sent out daily. Mr. Tucker is in charge of our clocks.

Meridian Circle Observations.—Mr. Tucker has completed a fine series of observations of all stars contained in any of the great ephemerides and not contained in the Berliner Jahrbuch. This work is all ready to print. He has also determined the places of a long list of stars used by Prof. Doolittle to determine the latitude of Lehigh University. The division errors of the 1° spaces of both circles of the instrument have been determined by Mr. Tucker with the assistance of Mr. Aitken.

Meteorological observations (tridaily) have been regularly made. They are now in charge of Prof. Aitken. A summary of all meteorological observations made here from 1888 to 1897 is in course of preparation by Mr. Perrine.

Earthquake observations are obtained on our two seismographs, which are in charge of Mr. Perrine. A complete list of all recorded earthquakes on the Pacific coast from 1769 to 1897 has just been prepared by Prof. Holden.

Publications of the Observatory.—The observatory has already issued three quarto volumes and five octavos, besides several pamphlets and the Moon Atlas. The Smithsonian Institution has lately published an octavo prepared here by Prof. Holden — Mountain Observatories—and will probably print his list of recorded earthquakes just mentioned. Notices from the Lick Observatory regularly appear in the publications of the Astronomical Society of the Pacific. More than 1,200 contributions to astronomical and other journals have been made by the officers of the observatory since 1888.

Trial of the Crossley Reflector.—This fine instrument, which had done such good work in the hands of Mr. Common, was presented to the Lick Observatory by Mr. Crossley in 1895. It was completely mounted in June, 1896, and given over to Prof. Hussey for trial. The work begun in 1896 is now being prosecuted. Photography in the Newtonian and principal foci will be tried by Prof. Hussey, and Prof. Campbell has a programme of spectroscopic observations to be carried on with the Bruce spectrograph (constructed here) in the principal focus. A powerful driving clock (the Bruce clock) has been made here from drawings by Prof. Hussey. It is essentially a copy, in little, of the Warner & Swasey clock of the 36 inch equatorial. Its conical pendulum weighs about 36 pounds.

The Schaeberle 18 inch reflector has been used for some years past in experiments in celestial photography by its maker, Prof. Schaeberle. Very interesting photographs of Jupiter have been obtained.

The Crocker photographic telescopes (a pair of Willard portrait lenses) will soon be mounted in a new dome near the Crossley reflector. A 12 inch mirror (by Prof. Schaeberle) of very short focus is to be mounted on the same stand.

Lick Observatory, July 7, 1897.

CHEMISTRY AND ARCHÆOLOGY.

THE fact that all the sciences are intimately allied, and that any one of them may be called upon to serve as the handmaid of any other, is once more exemplified by the services recently rendered to archeological research in France by some analyses made by the eminent chemist M. Berthelot, and described by him in the Comptes Rendus of the Academy of Sciences. By analyzing the metal of some early implements recently unearthed in Chaldea, he shows that they are pure copper—not bronze, as had been supposed—and throws interesting light on the methods and processes of metallurgy in those early times. The Literary Digest translates as follows:

"The discoveries made in Chaldea, at Tello, several years ago, by M. de Sarzec have made known to us monuments of great antiquity, going back to the origins of civilization, that is to say, five or six thousand years. They have furnished, among other things, arms, ornaments and utensils capable of throwing new light on the origin of the metal industries. Such are the objects deposited in the Louvre Museum, which M. Heuzey, my colleague, has submitted for my examination.

"I present herewith the results that I have obtained, which form a part of a methodical series of researches that I have been making for several years on the metals of ancient civilizations. The result has been a distinct advance in our knowledge of these interesting questions. In fact, we have here the earliest and most ancient records belonging to the copper age, whose date is definitely known."

The detailed results of a chemical analysis of various objects found in Chaldea are next given, and it is proved that such objects are practically pure copper, although many of them are labeled "bronze" in the museums. Says M. Berthelot:

"The existence of successive stages in the use and purification of metals, whether common or precious, follows from all these analyses. In particular, the employment of pure copper for making arms and utensils, even of current use, in Chaldea, about 4000 B. C., is established by the analyses. It preceded the use of bronze, that is of copper alloyed with tin, which is found in later objects, in Chaldea as in Egypt. We may even add that the form of doweled axes and the processes of manufacture, as well as the practical uses for which these utensils were destined, were the same for the pure copper axes of Chaldea as for the prehistoric bronze axes of Europe and Siberia. These observations appear to me the more worthy of interest, in that they are made on authentic objects that date in Chaldea and in Egypt from times that may properly be called historical—conditions not satisfied in the same degree by pure copper objects found in Europe. The discoveries made in Egypt and in Chaldea cast new light on problems that relate to the origin of metal industry in the history of the human race."

THE PATENT SYSTEM AS A FACTOR IN NATIONAL DEVELOPMENT.*

By WILLIAM C. DODGE.

THE question is sometimes asked: Is a patent system of benefit to a country? and not infrequently we find men and papers advocating the abolition of patents. Those who entertain such ideas generally belong to one of two classes—persons who confound modern patents with the "odious monopolies" of former times, and who think that inventions would be secured just as well without patents, and those who think that labor saving machines deprive men of employment, and are therefore injurious to the laboring classes.

This opposition has exhibited itself from the beginning down even to the present day. It is but a few years since a writer in a paper published at the capital of the United States asserted that "the invention of the steam engine and the sewing machine were among the greatest evils that ever befell mankind;" and it is a matter of history that in the same enlightened land prayers were offered in some of the churches that the wickedness of the newly invented sewing machine might be made apparent, and it makers be struck with a conviction that would induce them to stop its manufacture!

More recently an organ of a labor organization insisted that the introduction of patented machinery worked injury to skilled labor, as have also the leaders of some of these organizations, and writers in periodicals, during the past year.

It is to correct these erroneous impressions that I present the following facts.

If those who confound modern patents with the "odious monopolies" granted by the monarchs would but consider for a moment, they would see how erroneous such an idea is.

Under the old system of "monopolies," rights of which the public were already in full possession were arbitrarily taken from the public and conferred upon individuals, greatly to the injury of the public. For instance, Queen Elizabeth bestowed upon her favorites the exclusive right to sell steel, salt and other articles in the kingdom, the price of salt by the monopoly being increased from sixteen pence to fifteen shillings—over eleven hundred per cent.

On the contrary, a patent, instead of taking from the public anything which it already has, induces the inventor to spend his time, labor and money, and exercise his genius, in devising and giving to the public something new—something which it wants, and which, but for his invention, it might never have had. True, it gives him the exclusive right to make, sell, or use the invention, but only for a brief period, and that only upon the condition that he shall so illustrate and describe it that the public can make and use it at the expiration of his limited right, and thereafter have it free forever.

The difference between a modern patent and an old time monopoly is as clear and as distinct as the difference between day and night, and there is no excuse for their being confounded by any intelligent person. In fact, it was to abolish and prohibit the "odious monopolies" that the patent system was established.

In no part of the world have inventions been so extensively made and used as in the United States, and there can be no better way of determining whether the patent system has been beneficial, and whether or not it is for the public good to continue it, than to consider what it has done for that country.

To get an idea of what has been accomplished during the first century of American existence under the patent system, let us briefly compare the condition of the United States in 1790 with that of 1896.

Their territorial area has increased from 830,000 square miles to 3,314,230; their population from 4,000,000 to more than 70,000,000; their 75 post offices to about 70,000; and their 1,500 miles of postal routes to nearly 500,000 miles, on which there is a travel of 409,398,425 miles—enough to encircle the globe more than 16,000 times! In 1790 they had practically no manufactures. At the close of the revolution their manufactures amounted to only $20,000,000, the total product as late as 1830 being but $80,000,000; while in 1890 their manufactured products amount to almost $9,250,000,000—far more than those of Great Britain, and more than one-third of the total manufactured products of the world. At the same time their agricultural products have grown to the sum of $4,500,000,000 per annum.

In 1790 such things as steamboats, railroads, telegraphs, and telephones were unknown, while now the United States have 181,000 miles of railroad, with a total trackage of 221,000 miles, giving employment to about 800,000 persons.

The street and suburban railways aggregate nearly 40,000 miles, of which nearly one-third are electric roads, with 30,000 motor cars.

On the 15,000 miles of Western navigable rivers and 95,000 square miles of lake surface there are 2,705 steamers, with a tonnage of 806,584 tons, while the craft on these inland waters number 10,237, with a tonnage of 4,319,734 tons. The traffic on the great lakes alone amounts to nearly 40,000,000 tons. During the eight months of navigation 60,000 vessels pass through the Detroit River, with a tonnage of over 36,000,000 tons. The tonnage of entrance and clearance of the two ports of Chicago and Buffalo exceeds that of any city in the world, except London, and very nearly equals that (London, 20,902,534; Chicago, 10,288,868; Buffalo, 9,500,500). From the single port of Escanaba, on Lake Michigan—a place so young as to be unknown abroad, and known to but few at home—there were shipped in 1892 nearly 4,000,000 tons of iron ore and 120,000,000 feet of lumber, her tonnage being more than half of that of Liverpool, which is excelled only by that of London.

The United States produce now more iron ore and manufacture more iron and steel than Great Britain, which heretofore has led the world in that line. They have 800,005 miles of telegraph wires, with 25,000 stations, independent of ocean cables, and 440,730 miles of telephone wires, with more than 500,000 instruments in use.

But, wonderful as these statistics show the growth of the country to have been, they do not tell the whole story; for it must be borne in mind that in 1790 the four millions of people were scattered mostly along the Atlantic seaboard in sparse settlements. Moreover, it must be remembered that this small number of settlers had the whole continent to subdue—forests to clear, farms to open, houses, roads, bridges, schools, and churches to build, in fact, everything to create, with the savages to contest every foot of advance—and that the western continent had neither the accumulated wealth nor the surplus labor of the old world with which to accomplish this gigantic task. But even that is not all, for, in order to get a clear idea of the conditions under which the United States began existence as a nation, one must consider also the restrictions placed upon the colonists by the mother country.

The policy of the mother country from the very first was one of suppression of all manufacturing industries. As early as 1621 an order of the king and council prohibited the shipment of tobacco or any other production of the colonies to any foreign port, except to be first landed in England, and a duty paid on it there.

This policy was continued even after American independence, and various acts, from 1781 to 1790, were passed, prohibiting under heavy penalties the shipment from Great Britain of "any machine, tool, engine, press, paper, utensil, or any part thereof, or any model or plan thereof, which was, or thereafter might be, used in the manufacture of woolen, cotton, linen, or silk manufactures," and also prohibiting the shipment or enticing away of any artificer or workman in these several branches; and in 1795 this act was made perpetual.

It was not until 1825 that the restriction upon workmen leaving the country was repealed, and that upon machinery not until 1845.

The object of all this, as stated in the preamble to the act of 1763, was "the keeping of his majesty's subjects in the colonies in a firmer dependence," "the increase of English shipping," and "the vent of English manufactures." The idea and purpose of the British government in reference to the colonies was succinctly stated by Sir Robert Peel, when he said: "It is the destiny of the United States to feed Great Britain, and the destiny of Great Britain to clothe the United States."

Of course, under such control by the mother country, the colonists could engage in nothing but farming and the production of raw material, to be shipped to England for the use of her manufacturers.

During the revolution manufactures were established to partly supply home needs, but with the close of the war a reaction set in that soon destroyed most of them. Under the confederation of the colonies, which was solely for common defense, the general government had no power to grant patents, or to regulate commerce, or to impose duties on foreign goods, those rights being exercised by each colony or State as it saw fit. Massachusetts, New York, and those most interested in commerce, imposed no duties, and the result was that, in a year or two after the close of the revolution, the country was so flooded with the cheap products of England and other countries as to break down all the manufactures that had been established during the revolution and bankrupt the merchants. So terrible was the condition of affairs that petitions were sent to Congress asking it to issue "fiat" paper money, and loan it to the people. In Pennsylvania the State government actually did this.

It was this condition of affairs which finally resulted in the constitutional convention in 1787, which conferred on Congress the powers under which the country has since grown to its present estate. Among the powers conferred on Congress by the Constitution, two of the most important, so far as national prosperity and growth are concerned, are the power to regulate commerce and impose duties on imports and the power to provide for the grant of patents. These may well be termed the right and left arms of American growth

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and prosperity, and it is a question which, after all, is the right arm and which the left. Under the exercise of those two powers, for the first century of existence, the United States have so grown and prospered that they now do one-third of the world's manufacturing, one-third of its mining, and one-fifth of its farming, and possess one-fifth of its wealth. And, best of all, this is the result of peace and the intelligent application of the arts.

Now, what has caused this marvelous growth? Doubtless there are several causes. The cheapness of a virgin soil and free institutions inducing immigration from abroad were two of the causes; but these alone do not account for it.

By some it is contended that the tariff has been the prime cause of American prosperity. Without desiring to discuss that or any political question, and admitting that a tariff is necessary for national revenue, and that it has been, and is, of importance to the manufacturing interests of the country, I assert, without fear of successful contradiction, that the patent system of the United States has been, and is now more than ever, one of the prime causes of national growth and prosperity.

As stated by Commissioner Leggett in his report for 1878, from three-fourths to nine tenths of all American manufacturing is based, directly or indirectly, on patents; that is to say, the people are engaged in manufacturing patented articles, or are using patented machines and processes to manufacture articles not patented.

One need but step into any shop where articles are being produced—from the saw mill in the woods that now cuts its 300,000 feet per day to the little shop in the attic where toys are produced, or the great factories turning out their millions' worth of articles of every variety—to prove the truth of this statement. In fact, you cannot touch a thing anywhere, in the shop, on the farm, in the household, or the office, that does not bear the impress of patented inventions.

But to show that this is not merely an individual opinion, let me quote what an intelligent Englishman says on the subject. Harris Gastrell, secretary of the British Legation, in a detailed report a few years since to his government upon the industries of the United States, says:

"I cannot close this report without recording the fact that, in every important branch of industry referred to in the course of the previous pages, the American manufacturers seemed to be ever gaining on their competitors of the old world by availing themselves to the utmost of every advantage of improved process or labor saving machinery which American or other inventors may offer.

"There can be little doubt but the celerity with which all such advantages are thought out and then introduced into general use is owing to the constant pressure of high rates of wages and the comparative certain protection of capital invested in inventions.

"Neither can I close without observing how favorably the great industries of the United States would probably compare with the best organized of the competing industries of Europe. The past history and present development of the textile (and metal) industries is an earnest of a prolific future. Whether or not a reduced cost of living shall ever be attained, I cannot doubt that, under sound conditions of production, American industry will not only supply its own market, but will also become a formidable competitor in foreign markets in many articles.

"How soon that competition abroad may take place in this or that industry is not for me to conjecture. But I think that the data in this report are sufficiently full and correct to enable others to predict that time in respect to the cotton and woolen industries."

At a meeting of the British Association, after his return from the Philadelphia Centennial Fair, Sir William Thomson said:

"I was much struck with the prevalence of patented inventions at the exhibition; it seemed to me that every good thing deserving a patent was patented. I asked one inventor of a very good invention: 'Why don't you patent it in England?' He answered: 'The conditions are too onerous.' We are certainly far behind America's wisdom in this respect. If Europe does not amend its patent laws, America will speedily become the nursery of inventions for the world."

Mr. Hulse, the English judge of textiles, in his report to Parliament, said:

"The extraordinary extent of ingenuity and invention existing in the United States and manifested throughout the Exposition I attribute to the natural aptitude of the people, fostered and stimulated by an admirable patent law system."

So, too, the Swiss commission were so impressed by what they saw at Philadelphia that they published an address to their manufacturers, in which they told them that their only hope was in the adoption of a patent system; and the result was that Switzerland in 1888 adopted a patent law.

The United States consuls, in their reports to the State Department on the effect in Europe of the Centennial Exhibition in 1876, show how American implements and products were being preferred in Europe, especially agricultural machines and tools; and Consul Winser gives long extracts from a book published by Dr. Herman Grothe, a prominent German political economist, who visited the fair for the sole purpose of "studying the principles which had operated so powerfully in bringing about this rapid and high development of American industries," and who lays great stress on "the stimulating effect of the patent laws."

Dr. Grothe further says:

"Moreover, owing to the use of labor saving machinery and finer and better adapted tools, the cost of manufacture, in spite of higher wages in the United States, is lessened to the point where competition with other nations in supplying foreign markets may fairly be tried; and there can be no doubt that a great many lines of American wares will eventually find ready sale in the German market, in some cases to the exclusion of the same classes of goods of English, French and even home manufacture. All this is granted."

In the reports of the British commissioners to Parliament it was stated that, "as regards extent of invention and ingenuity, the United States was far ahead of other nations;" that "a great part of the marked advance in the improvement of workmen's tools which has been made during recent years is justly due to the inventive genius of American citizens;" that "one cannot fail to notice the great fertility of invention displayed in America;" that "there is great inventive power, and a ready and fearless adaptation of the means to the end sought;" that "no one could fail to be struck with the great and successful application of science to useful purposes in America;" and that, "judged by its results in benefiting the public, both by stimulating inventors and by giving a perseveringly practical turn to their labors, the American patent law must be admitted to be the most successful, and the beneficence of its working was very amply illustrated throughout the American region of the Exhibition."

Edward Bally, one of the Swiss commissioners, said: "I am satisfied from my knowledge that no people have made, in so short a time, so many useful inventions as the Americans; and if to-day machinery apparently does all the work, it nevertheless by no means reduces the workman to a machine. He uses a machine, it is true, but he is always thinking about some improvement to introduce into it, and often his thoughts lead to fine inventions or useful improvements."

As a result of these obvious facts, a committee of the British Parliament some years ago, after two years of investigation, recommended the adoption of the American patent system, and again in 1894 the subject was agitated. Norway and Sweden in 1885, Canada in 1886, and Germany in 1888 adopted a similar system of preliminary examination, and now they grant patents only for what is new and original. Thus the foremost manufacturing nations of Europe recognize the superiority of the American patent system, and make acknowledgment of its beneficial results.

Now, when the United States manufacture more than they consume and seek other markets for a surplus of both manufactured and agricultural products, the patent system more than ever becomes important; for, with higher priced labor and raw material, how are goods to be made there, and sold in Central and South America, in open competition with the cheaper labor and cheaper raw material of England, France, Belgium and Germany? If the cost of both labor and material could be reduced to a European basis, then, of course, America could compete; but that can not be done, for the price of labor cannot be fixed by law, nor would the United States want to reduce it, if it could. That was tried in England, and also in New England, and abandoned centuries ago.

The main hope is in inventions and the skill and energy of the American people. If inventors can furnish manufacturers with improved machines and processes, which will reduce the cost of production from fifteen to twenty per cent., then the new world can compete with the old world; otherwise not. Already that point is rapidly approaching, as the following facts show:

In 1850 the manufactured products of the United States amounted to but	$90,848,210
By the census of 1850 they had grown to ..	1,019,106,616
" " 1860 " " " ..	1,885,861,676
" " 1870 " " " ..	3,385,860,354
" " 1880 " " " ..	5,369,579,191
" " 1890 " " " ..	9,224,541,091

Or, according to Mulhall, more than one-third of the total manufactured products of the world!

This remarkable increase has been largely, if not mainly, due to inventions, stimulated and fostered by the patent system. As proof of this I cite the fact that the amount per hand employed has constantly increased. For instance, as shown by the census reports, in 1850 the product per hand, yearly, was $1,564, while in 1890 it had grown to $2,250—an increase of nearly 44 per cent. in forty years. During that time the hours of labor have been reduced at least 20 per cent., and yet the product per hand has increased, as above shown. Nor is this all, for, while the hours have been decreased, and the product increased, the wages paid those hands have increased in even greater ratio, or from an average of $247 per year in 1850 to $450 in 1890, an increase which is even further augmented if measured by the purchasing power of a dollar then and now.

Now, how is it, and what is it, that enables an operative to-day to produce so much more, in a less number of hours, than he could thirty or forty years ago? It is simply invention, as embodied in the improved machines, tools, processes and appliances that American inventors are constantly furnishing to American manufacturers.

Near Baltimore there was recently erected one of the largest plants for the manufacture of Bessemer steel in all its forms in the world; and, as recently stated by its superintendent, by means of the inventions and improved appliances they have adopted they are enabled to produce a ton of steel with but one-third of the manual labor required at their other establishment, built twenty or twenty-five years before.

In 1866 steel rails cost $165 per ton. In 1884 they had dropped to $34, in 1893 they were $21 to $24 per ton, and in 1897 even less. See how that has expedited the building of railroads, which now cover the country like a network, and without which modern existence could not be carried on. And the same is true of steel in all its forms, so that to-day we build steel bridges, steel vessels, steel cannon, steel frames for our buildings, and for farm implements, and use steel nails.

Inventions and improvements have so reduced the cost of steel rails that already, during the year 1897, the United States have sold 100,000 tons to Europe. They sold 100,000 tons of pig iron from the Southern States in 1896, and this year it is estimated that it will be 250,000 tons, where before the war none was produced. In 1896 the American export of iron and steel, manufactured and unmanufactured, amounted to over $11,000,000.

As an illustration of the benefits of invention, take the common nail. In 1818, when they began to be made by a machine operated by hand in Pennsylvania, they cost from 18 to 37½ cents per pound, according to size. Now they are sold at 1 to 1¼ cents per pound—so cheaply indeed that a carpenter, working for 30 cents an hour, had better let a nail go than to spend ten seconds to pick it up, for ten seconds of his time is worth more than the nail!

In a report made by the United States consul at Birmingham, he cites a paper prepared by an English expert, who forcibly describes the danger from American competition to the British manufacturer of steel.

That is the result of invention. And the same is true of nearly all branches of manufactures. Says the Iron Industry Gazette:

"Disparagement of patents is common and easy, but it should not be forgotten by those who sneer at inventors that, out of a total of over $8,100,000,000 of capital invested in manufacturing in the United States, patents form the basis for the investment of about $6,000,000,000. Evidently, the United States system of encouraging invention that has resulted in the patenting of over 540,000 inventions is a system that is exceedingly wise and valuable. The one thing that has enabled manufacturers to make so wonderful a progress in the United States is its patent system."

PHYSIOLOGICAL EFFECTS OF MENTAL WORK.*

WITHIN the present decade the relation between mental work and the bodily processes has been the subject of much study. Interest in the problem as a field for practical inquiry was first aroused by a paper on the fatigue resulting from intellectual work, published by Sikorsky in the Annales d'Hygiène Publique for 1879. He was followed more than ten years later by Burgerstein, Laser, Griesbach and others. In these investigations the method used was that of testing school children in classes. Various problems and exercises were set before them, during and after the school session, and the percentage of errors committed in the operations was taken as measure of the fatigue due to mental work. While some individual errors might be due to other causes, the average percentage of the entire class seemed a fair test of this factor. The latest instances of this method are the investigations of Friedrich and Ebbinghaus, described in the May number of the Naturalist. At about the same time Mosso and his pupils took up the question from another side. They instituted a series of laboratory investigations upon single individuals by means of the ergograph, with a view to determining the fatigue due to steady intellectual as well as physical work. Kraepelin and his pupils meanwhile undertook the same problem, varying it with tests of the influence of various stimulants and narcotics on the capacity for mental work. They made use of the reaction time method, as well as the percentage of errors. More recently, Binet and his pupils have taken up the subject from a different standpoint, their object being to measure the effect of mental stimulation and mental effort on the bodily processes of breathing, heart action, etc. Several other investigators have studied the problem in one or other of these forms. Among them may be noted Féré, Patrick and Gilbert, Frey, Bolton, Bergström and Henri.

In an article in the Année Psychologique for 1896, M. Henri gives a résumé of the various investigations and the methods used in each. He emphasizes the importance of distinguishing the different factors involved in both mental and physical work, and of studying each one separately by appropriate experimental methods. Among these factors he specifies in particular attention, voluntary effort, the psychic processes of memory and imagination. Little progress has as yet been made in the way of investigating effort, except in the study of pathological cases, such as aboulia. As for attention, while considerable work has been done in this field, the investigations have generally had for their end to determine the mental effects of fatigue and other variations in the conditions, rather than to measure the physical effects of variations in the attention. Memory has been, perhaps, more systematically studied than any of the other factors.

The investigation of the effect of intellectual work on the pulse and other functions which MM. Binet and Courtier have undertaken seems most likely, of all methods so far devised, to furnish a measure of psychical work in physical terms. A series of papers on the subject by these authors has appeared in the Année Psychologique, the first in the issue for 1895 and four others in the last volume.† In approaching the question it was first of all necessary to study the effect of changes in respiration on the heart beat and blood supply. A large part of the first paper is accordingly taken up with this and with an examination of possible errors in the apparatus. The instrument used was the plethysmograph of Hallion and Comte. This consists of a rubber cylinder, which is grasped firmly by the hand. The outer surface of the hand is covered with a tight-fitting glove, so that any expansion in volume of the hand (due to increased blood pressure) takes effect on the inner surface, and results in diminishing the volume of the rubber cylinder. The latter communicates by means of a tube with a flexible drum. When the cylinder is compressed by the hand the drum rises, and the effect is recorded by means of a pen attached to the drum. The apparatus was found to be very serviceable, and was remarkably free from error. In addition to the frequency and strength of the pulse beat, the dicrotism, or break in the beat, was clearly marked in the diagrams, and proved an important factor in the results.

MM. Binet and Courtier note the existence of important individual differences in the effects of mental work on the physical processes. In some subjects these are confined almost wholly to changes in the respiration, in others to the action of the heart, while in others they are felt more especially in the vaso-motor system. In general, the effect on the respiration is to make it more rapid and at the same time more superficial. The effects on the pulse curve most frequently observed are: 1st, diminution of amplitude; 2d, diminution of amplitude with change of form; 3d, diminution of amplitude, change of form and lowering of the level of the curve. One or other of these effects appears in almost all the subjects tested.

In their later papers the authors consider in turn the various causes of change in the pulse. They confirm the well known diurnal changes by numerous observations with their own method, e. g., that the pulse becomes more frequent and the dicrotism generally more marked immediately after a meal. As regards physical exercise, they lay special stress on the changes that occur in the dicrotism according as the exercise is local, general and moderate, or general and fatiguing.

The study of the effects of mental work is, of course, the most important from the psychological standpoint, and here the authors have sought to combine tests of

* The American Naturalist.

† Vol. III. 1896, published this spring.

the heart and respiration with those of the pulse. In addition to the more delicate tests, involving simple mental operations, two of the subjects undertook a piece of severe and prolonged mental work. They spent seven hours working steadily at this task, merely resting at the end of each hour for a time sufficient to perform the necessary tests. Comparing the results with those of a similar period passed under similar conditions but without work, the pulse was found to be considerably retarded in the former case, as compared with the latter, the retardation taking place especially in the early part of the period. The authors sum up their results on mental work as follows: "1. An energetic but short mental effort produces an excitation of function, vaso-constriction, acceleration of the heart and of the respiration, followed by a very slight retarding of these functions; in some of the subjects a blunting of the dicrotism. 2. Intellectual work lasting for several hours, with comparative immobility of the body, produces a retardation of the heart and a diminution of the peripheral capillary circulation."

As regards the relation between physical and mental work, the authors are cautious in drawing conclusions. They observe a certain parallelism, in that a single energetic effort produces an acceleration of the heart and lungs, while a long-continued and fatiguing effort frequently weakens the dicrotism. On the other hand, the excitation of the heart is more marked and the acceleration of the respiration greater in physical than in mental work; again, in physical work the respiration grows deeper, while in mental work it becomes more superficial; and finally, prolonged mental work tends to produce a weakening of the peripheral circulation—an effect not observed in the experiments on physical work.

The effects of emotion on the heart and pulse are the topic of the last paper by the same authors. The experiments on this difficult problem were contrived with considerable ingenuity. Some of the subjects were children of from eight to ten, in whom it was easy to excite fear, surprise, pleasure, etc. With adults the tests had to be more carefully planned. A false alarm of fire was prearranged in one case, and resulted in real fear on the part of the subject. Another subject, after being blindfolded, had his hands placed on a pile of worms. A number of tests embodying various emotions were successfully made. It was found that every emotion tended to weaken the pulse. The quality of the emotion, whether pleasurable or painful, had no marked influence—the contrast was altogether between a state of mental rest and one of emotional disturbance. The heart showed a tendency to accelerate when the excitement was strong, and here too no difference was observable between the pleasant and the painful. The influence on the respiration was most marked of all. Every emotional excitement produced an acceleration and at the same time an increase in depth and a shortening of the pause.

The authors added a special study of the effects of music on these functions. Their experiments on this point were confined to one person—a man of fine musical appreciation and with considerable of a musical education. They represent, therefore, merely a single type of individual. There was found to be a distinct though slight quickening of the respiration and heart in consequence of hearing the tones themselves, and apart from any emotional "echo" aroused by them. When a melody was played, whether sad or gay, the acceleration was more marked, and it reached a climax when the piece was of a dramatic character and particularly fitted to arouse emotion. This acceleration, however, was not accompanied by any noticeable irregularity. There was at the same time in general a weakening of the capillary circulation, which was less when the sounds had merely a sensorial effect than when they produced a distinct emotional disturbance.

In summing up the whole question of emotional effects on the bodily functions, the authors again lay stress on the differences among individuals. From their own observations they are inclined to distinguish three separate classes of effects. 1. In a majority of persons every emotion produces a vascular constriction, an acceleration of the heart and of the respiration, and an increase of amplitude in the thoracic cavity. 2. In some few cases a sensation of pain or an emotion of sorrow may produce a slight retardation of the heart. And 3. It is possible, as observations made on one subject prove, that the form of the capillary pulse may change with the quality of the emotion; this last effect, they remark, may in time enable us to make a classification of the emotions according to their physiological effects on the form of the pulse.

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PREVENTION OF THE SLIDING FRICTION OF BALL AND ROLLER BEARINGS.

WHEN two parts of a machine displace themselves, one with respect to the other, to a circular motion, their friction develops stresses which are variable and which have the effect of absorbing a very appreciable part of the work developed by the motor. Such, for example, is the case with the pillow blocks supporting a revolving shaft. However carefully the lubricating be done, and whatever be the value of the lubricator employed, such frictions are inevitable: the pieces in contact wear irregularly, and, in the long run, there occur flattenings that still further increase the resistance to be overcome. It is for this reason that bearings are provided with linings of soft metal, bronze or regulus of antimony, which support all the wear and are easily replaced.

General Morin's experiments have permitted the fact to be recognized that under proper conditions of manufacture and lubrication, the coefficient of the sliding friction of a shaft in its bearings is 0·054.

In calling T the work absorbed by friction, P the stress exerted, C the path traversed, and F the coefficient of friction, the value of T is given by the formula:

$$T = P \times C \times F.$$

It will be seen from a simple inspection of this formula that the work absorbed by friction is so much the less in proportion as the coefficient of friction is less. An endeavor has, therefore, naturally been made to find a means of substituting rolling friction, the coefficient of which is much less (0·001, according to Poncelet), for sliding friction. Were such substitution perfectly realized, it will be seen that in this second case the friction would be 54 times less than in the first. But in practice we are far from reaching such a result. In fact, roller bearings and ordinary ball boxes with cells, perforated disks, superposed rings, etc., only partially suppress sliding friction, a notable part of which is simply displaced, as may be easily seen from an inspection of Fig. 1.

Let A be a shaft revolving in the direction shown by the arrow and bearing against a series of rollers, B. Through the motion of the shaft, these latter will revolve in a direction opposite that of the latter and will rub against each other at their points of contact, a, since at such points each will revolve in a direction opposite that of the other.

As may be seen, the addition of the rollers has no other result than that of transferring to the points, a,

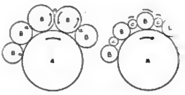


Fig. 1 Fig. 2

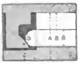


Fig. 3

the sliding friction that was developed previously upon the circumference of the shaft, in diminishing it, it is true, but without suppressing it. In fact, calculation shows that by the substitution of ball or roller bearings for smooth ones, the saving in the work of friction reaches, at a maximum, 40 per cent. And yet this figure diminishes rapidly as a consequence of the wear that is inevitable, even with the use of pieces of steel, tempered and trued after tempering.

In order to obviate the sliding friction of rollers, B, M. G. Philippe has conceived the ingenious idea of isolating the rollers from each other by means of intermediate and smaller ones, C, which revolve in a direction contrary to that of the first, that is to say, in the same direction as the shaft, A.

A simple inspection of Fig. 2 will show that there is a rolling friction at the points of contact of the rollers, B and C, as well as between the rollers, B, and the shaft, A.

We have here supposed a case of rollers, but it is evident that the results will be the same when balls are employed. The sole condition to be realized is to select the diameters of the large and small balls in such a way that the paths traversed shall be equally proportional.

Fig. 3 supposes a case in which the axis, O, in revolving, carries along the large balls, B, which roll in the compartment, A, and communicate their circumferential velocity to the small intermediate balls, H. The latter are kept in place by means of a path, C, upon which they rest by their extremity, D, and which is cast in a piece with the chamber, A. In order that the paths traversed shall be equally proportional, the diameters of the elements must satisfy the following equation:

$$\frac{B}{A} = \frac{C \times H}{B \times D}$$

C and D are here the diameters of contact.

M. Philippe has studied various arrangements that permit of the application of his system to the most ordinary uses of mechanics. Figs. 4 and 5 give two arrangements of roller cages that may be applied almost without change to the present pillow blocks. In the fifth, the path, C, is connected with the bearing, A, while in the fourth it is connected with the shaft, O.

Fig. 6 gives the arrangement of a bicycle hub with ball bearings, the regulation of which is effected, as usual, by tightening the cone. The hub for light vehicles (Fig. 7) is, as may be seen, analogous to the preceding. These hubs for light vehicles will prove useful in automobile carriages, where, more than anywhere else, the necessity has made itself felt of suppressing friction in order that the motor may suffer no loss of power. When there are heavy loads to be supported, rollers rather than balls should be employed.

American electric tramway companies frequently

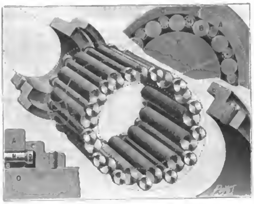


FIG. 4.—MOVABLE ROLLER CAGE WITH PATH CONNECTED WITH THE SHAFT, O.

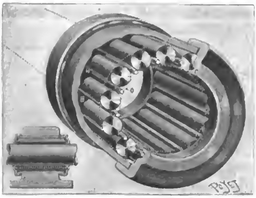


FIG. 5.—MOVABLE ROLLER CAGE WITH PATH CONNECTED WITH THE BEARING, C.

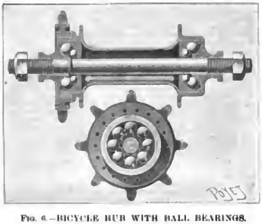


FIG. 6.—BICYCLE HUB WITH BALL BEARINGS.

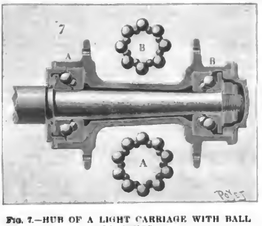


FIG. 7.—HUB OF A LIGHT CARRIAGE WITH BALL BEARINGS

make use of roller bearings, but in employing the different ordinary systems of which the capital defect has been shown above.—La Nature.

A PORTABLE RECORDER FOR TESTS OF METALS.*

By Mr. G. C. HENNING, New York.

WHEN it is desired to know all about the working of a steam engine, to study the working of the steam valves, piston, clearances, etc., the indicator is used; this gives a record on rectangular co-ordinates of travel of the piston, and to the steam pressures throughout the complete cycle. Similarly, if it were possible to design an instrument like the indicator in its accuracy, portability, and universality, to record the behavior of materials from beginning to the end of the test, it ought to be of general utility for it, and its introduction ought to be comparatively easy. It should be complete in itself, readily and quickly applicable to all testing machines, and should be so constructed as to be readily examined for accuracy, and should, of course, be durable.

A great many recording instruments for stress-strain diagrams have been designed and used from time to time, but all have been found wanting in one or more respects, and not one has been made portable, so that engineers could take it from works to works and use it without first being compelled to make more or less costly mechanical preparation for its use in each case. Moreover, the instruments in almost every case are so costly that their general introduction and use became impossible, especially in view of their limited utility. Some of them, otherwise very ingenious, gave diagrams on circular co-ordinates which made them practically useless. Among apparatus used for this purpose may be mentioned those of Wicksteed, Unwin, Kennedy, Barr, Gray, Martens, Olsen, Mohr and Federhaff, and of Grafenstaden, but as they are fairly well known, it is not necessary to describe them in this paper. My conception of a practical recorder for testing materials is as follows:

It must be portable and compact, requiring no extra precautions in adjustment or regulation, and without having the accuracy of an instrument of precision, must be perfectly trustworthy, and as correct as the other apparatus in connection with which it is used. It must cover a wide range of work, of short and long, large and small test pieces, such as are found in general use, and must be applicable to hard and soft materials as well. The apparatus should be applicable in a horizontal as well as in a vertical position. Moreover, it should give a complete record from beginning to end of the test, showing the more important elements on an enlarged, and the lesser on a natural scale. Thus, while elongations within the elastic limit—yield point—are very minute, and must be recorded on a magnified scale which is trustworthy, changes of length beyond this critical point are very large, rapid, and variable; hence measurement with a steel scale suffices, and the record on a diagram may be on actual scale. This change of scale must, however, be positive, controllable, and at a fixed instant or point, and must not introduce errors in the record. In case of materials of slight extensibility, however, the entire record should be on one scale from beginning to end, and the instrument should be so attached that it does not nick or injure the material so as to affect its point of rupture or strength.

As materials under test change shape rapidly and constantly, the instrument must be so designed that this variation does not introduce errors by slipping or tilting or otherwise. Means must be readily applicable which will check the accuracy of the instrument at all times. As materials are generally tested at the present time, there is no lasting record of the qualities that are claimed to have been found. Moreover, it is well known that many properties of materials cannot be determined except by an autographic stress-strain diagram. The curves obtained vary according to the treatment which the material has been subjected to, and annealing or straining produces such marked results that an autographic record would at once indicate how the material has been treated. Hardening, cold rolling, tempering, and other processes are made apparent by the characteristic features of the curves. With the use of such a recorder, it would become instantly apparent whether material had been previously intentionally strained to raise the elastic limit, as is well known to have been done. Overheating of material would be clearly indicated by the change in the curve, and the general uniformity of any lot of material could be readily determined.

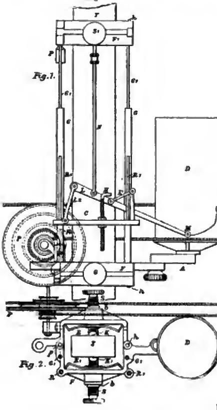
The instrument should also be applicable for compression tests, so as to record the behavior of material when subjected to compressive stresses. The engraving shows my design of such portable recorder, as based on the conception as explained. Two hinged frames, F and F_1, are provided with knife-edge pointed screw, S, passing through bushes, b, which carry springs, E. Hinge pins, h, allow the frames to open, while taper plugs, p, secure them rigidly together when closed around the test piece, T. In order that the knife edges, K, in the upper and lower frames, bear on the test piece, T, at given known distances, the guide rods, g_1, sliding in tubes, g, are made of a certain length. These rods, g_1, and tubes, g, cause the frames, F and F_1, to recede from or approach each other without changing their parallelism, and prevent any possibility of rocking of the lower frame, F, which carries the drum, D, on the arm, A. The drum, D, must remain at a uniform distance from the axis of the test piece throughout the test, as any change therein would vitiate the record materially, either increasing or reducing the apparent length of string, C.

The lower frame, F, also carries a parallel motion, G L, as in ordinary use in steam engine indicators. This parallel motion is actuated by the upper frame, F_1, through the connecting rod, N, which is interchangeable for longer or shorter pieces. The lever, L, of this mechanism carries a pencil or pen at m, which draws a line upon the paper wrapped on D, either horizontal when the drum is revolved, or a straight vertical line when the drum is stationary, and the frames, F and F_1, approach or recede from each other. If the drum revolve while the lever, L m, moves, any curve may be obtained according to their relative motions. As the possible change of length of material during test and up to the instant of rupture is very great, a very long drum would be required to record it on a magnified scale up to that point; the parallel multiplying motion would also become very large and cumbersome. Moreover, the change of length within the yield point is minute, and cannot be recorded to any purpose except on a magnified scale. Now, therefore, to record the elastic changes of length on a magnified scale, and the permanent changes on a natural scale, as the latter are never measured closer than to the nearest $\frac{1}{16}$ inch, I employ the following devices: The stop, H, arrests the multiplying mechanism at any desired point, after which it moves as a unit, and any further change of length is recorded on natural scale. To act as described, the parallel motion mounted on the bar, G, has two tubes, R, sliding on rods, R_1, the latter only being fastened to the frame, F. These tubes, R, are split, and can be made to grip the rods, R_1, with any necessary pressure.

It will be seen that the total maximum resistance to motion between frames, F and F_1, is the friction of tubes, g and R, on rods, g_1 and R_1, and friction of pen, m. As long as the motion is recorded on a magnified scale this resistance will be only the friction of rods, g_1, in tubes, g, of pen, m, and the resistance of the parallel motion. Therefore the total resistance will be minute, and not likely to affect the record in even the slightest manner by slipping of the knife edges and frames. The paper on the drum must move past the pen, m, at a rate equal or proportional to the motion of the poise weight on the beam. As loads are large or small according to size and quality of test piece, the poise must travel more or less to balance it. As it is desirable, however, to record all tests on the same sized diagram, the travel of the poise weight is reduced or increased by a grooved pulley, P, round any groove of which the string, C, tied to poise weight, is wrapped; the free end of this string carries a small weight to keep it always at the same tension. On any other groove of the pulley, P, another string passing around the drum, D, is wrapped, which is kept at the same tension by a small weight at its free end. By a proper selection of position of the two strings on the various grooves of the pulley, any desired rotation of the drum may be obtained.

Application of Instrument.—A light pulley is secured to the frame of the testing machine, over which the string, C, passes, the other end being attached to the poise weight, or to any mechanism moving in synchronism with it. A sheet of paper being mounted on the drum, the frames, F and F_1, are opened after the screws, S, have been so adjusted that the distances between the knife edges, K and K_1, are about $\frac{3}{8}$ inch less than the thickness of test piece. Then the frames are placed around the test piece, which has been placed in the machine, the frames are closed, pins, p, are inserted, the string, C_1, is passed around D, and C round the proper groove on P, while the poise weight is at 0—zero—and the test may begin. If it is desired to draw a base line for measurements of elongation, the drum is given one revolution while the pen bears against the paper; it is not necessary—though it can readily be done—to draw the other axis to the base line, as the motion of the pen is always at right angles to it. If it is desired to mark the scale of loads on the base line, all that is necessary is to revolve the drum by running out the poise to the several load points, and then making a mark for each of them. Once this scale is determined, it will be the same in all work.

In the case of materials with very slight change of length, during the test the automatic stop is not used, and curves like those on diagrams 1 and 2 are obtained. When ordinary structural material is tested, the stop is used, and a curve like that on diagram No. 3 is obtained; in this the elongation is drawn on a multiplied scale from 0 to the point marked "Stop;" beyond this it is drawn to natural scale. The very decided change of direction at the point marked "Stop" cannot be mistaken for anything else. As all of the instruments hereafter made will have a multiplication of ten times, this point of change of scale will be even more clearly defined than on the card shown. An investigation of the effect of stretch of the string or wire has demonstrated that it is negligible, and the divisions marked on diagram 2 will prove this. That it should be so will be clear when it is remembered that the drum revolves with a constant resistance, and that the string itself is always under constant tension, due to the small constant



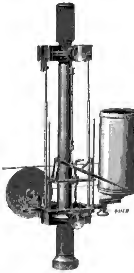
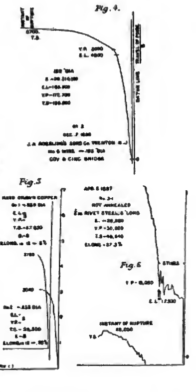


FIG. 3.



HENNING POCKET RECORDER.

* Iron and Steel Institute.

terweight tied to the string, C. It will be noted that at the instant of rupture the apparatus can separate into two independent parts, and that the knife edges permit a certain amount of slip; the combined effect of these two facts obviates any injury to the instrument at the instant of rupture, provided the accidental flying about of the gripping wedges is prevented by blocking them, which is always done by a careful person. Experience has shown that the instrument can be used rapidly without interfering to any degree with the work of the laboratory, and that the results are perfectly trustworthy.

[Continued from SUPPLEMENT, No. 1136, page 18156.]

PERPETUAL MOTION.—VI.*

FIG. 26 is an attempt to secure a perpetual motion by the application of electricity. It is the invention of a citizen of Kansas. In his communication inclosing the drawing, he says:

"You will observe friction (the old enemy) is an ally in this. If a magnet of a certain power will not move the electric plate, the power could be increased without perceptible loss of tension, by decreasing the resistance which the magnet and conductor offer."

In the engraving, A represents a frictional electrical machine; B, a crank; C, an electro magnet; D, wire conductors; F, a trunnion; G, an armature; E, a circuit closer; H, a pitman; I, an insulating substance; and J, spiral spring.

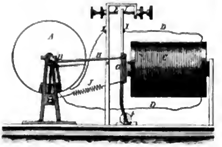


FIG. 26.

The device is expected to operate as follows:

The frictional electrical machine is started, which magnetizes the temporary magnet and draws the armature toward it. This breaks the circuit at the point, I, E, which demagnetizes the temporary magnet and allows the spring, J, to again close the circuit. By this means a continued motion is expected to be kept up.

To those not familiar with the science of molecular physics, this device may appear very plausible; a little reading, however, upon the subject of the correlation of forces will serve to show its utter fallacy.

Fig. 27 is the invention of Jean Clunet, of Lyons, France, patented in England, 1860, under the name of "A New and Improved Motive Power." It is thus described:

The invention relates to a new and improved motive power operating without noise and without expense. It consists in giving a rotary motion to a wheel, which is destined to transfer, by the ordinary means, the power obtained by the employment of any even, smooth blocks of stone, petrified mortar, iron, cast or wrought, or other heavy materials, in the form of cubes preferred, and of which the number and volume are governed by the amount of power desired, and causing them to descend in the ordinary atmospheric air, but to ascend in a liquid whose density is equal to their density, by which means their weight is annulled. For this purpose these blocks, when descending, are hung to hooks fixed to an endless chain turning upon the wheel receiving the motive power, which is of the shape of a hexagon, and placed on the top of a suitable framework, and upon another wheel of the shape of a square, which is placed at the bottom of said framework, and partially in a receptacle or tank of water, or any other liquid. When these blocks have arrived at the lower portion of their course, they detach themselves from the hooks on which hitherto they hung attached to the chain, which latter continues its ascending and rotary motion, and the said blocks descend and reascend within the tank, confined to their place and guided by an endless band and conducting wires stretched from supports for that purpose fixed on the top and bottom of the framework. They now, being thus guided, and following one upon another, find their way into another species of tank, placed vertically, likewise filled with a liquid similar to that in the first mentioned tank, and when arrived at the top of this second tank they tilt and slide along upon a horizontal shelf of rollers until they reach the hexagon-shaped wheel and the endless chain, when they recommence their descent. In order to prevent the liquid from running or descending from the second tank into the first, the blocks enter from one tank to the other between rollers and grooved pulleys pressed against the blocks by springs so as to shut off all way to the water. The detaching of the blocks from the endless chain takes place of itself, so to speak, from the position they find themselves in, in consequence of the rotary movement and of the turning over of the said chain upon the lower wheel in the shape of a square. The endless band receives a continuous descending and rising motion from the weight of the blocks, which give every motion that the apparatus possesses, and which motion would be perpetual, if, upon the axle of the hexagon-shaped wheel transmitting the force obtained to the machinery by means of a driving pulley keyed to one of its ends, there were not keyed to the other end a brake wheel with a hand crank, by means of which the movement may be stopped or modified. Instead of two receptacles, it would often be better to have but one, the rollers and grooved pulleys already alluded to being placed at the entrance of the single tank instead of the second, and acting in the same manner.

* Reprinted from the SCIENTIFIC AMERICAN, 1870-71.

The engraving is a side section, in elevation, of the whole apparatus.

A represents the blocks; B is the hexagon-shaped wheel; C is the endless chain, which remains attached to the said wheel by means of its pointed hooks, which successively enter similar recesses made in the circumference of the wheel, the other end of said hooks being square, serving to keep the blocks in their place while descending in conjunction with the conducting wires, D, placed two in front and two behind each block, and one at each side; E is the receptacle; F is the square wheel from which the chain, C, at the bottom of its course is detached to reascend round the wheel, B; G, rollers, of which there are four, made of India rubber or other elastic material, placed at the entrance of the receptacle, E; and H is the India rubber or other suitable angle pieces, also placed at the entrance, between which rollers, G, and angle pieces, H, pass with slight friction the said blocks, after being disengaged from the chain, C. These blocks, A, angle pieces, H, and rollers, G, being in close contact, form a permanent stoppage, so that the water cannot issue, and said blocks, when in the receptacle, are placed in the middle of the same, where they are kept in equilibrium by the water, and are pushed and moved forward by the blocks which descend after them. I is the endless band, resting on supports, J, fixed to the inside of the receptacle, supporting the blocks and moving with them. The blocks, when in the vertical part of the receptacle, are conducted by four wires, one on each of their four sides. K is a roller upon which tilt the blocks, guided by the endless band when on the top of the receptacle to leave the same; L, friction rollers, on which fall and roll the blocks after having tilted, in order to reach the hexagon wheel, B; M M are the two pulleys on each side of the hexagon-shaped wheel, for applying the brake and for transmitting the power obtained to other machinery. The equality in the density of the liquid and the blocks is obtained by hollowing the blocks so that they may easily rise to the top of the receptacle when therein. The desired result is obtained by the use of any other liquid, the volume of the blocks being proportionate to their density; also the weight of the blocks may be more or less than that of the liquid, but equality in weight is preferable.

No less a person than Sir William Congreve, M.P. and inventor of the famous Congreve rocket, figured in his time as a believer in, disputant upon and inventor of a perpetual motion. So sure was he that he had discovered the long-sought principle upon which self-moving machines could be constructed, that he patented his device, although we believe he never claimed to have succeeded in getting it to work. Nevertheless, he obstinately maintained that it would work, in spite of the mathematical demonstrations of the absurdity of his views made by several eminent mathematicians.

Fig. 28 shows this device. As will be seen, it is based on a principle hitherto not mentioned in this series of articles, viz., the power of capillary attraction.

Three horizontal rollers are fixed in a frame; an endless band of sponge runs round these rollers, and carries on the outside an endless chain of weights, surrounding the band of sponge, and attached to it, so that they must move together; every part of this band and chain being so accurately uniform in weight that the perpendicular side will, in all positions of the band and chain, be in equilibrium with the hypotenuse, on the principle of the inclined plane. Now, if the frame in which these rollers are fixed be placed in a cistern of water, having its lower part immersed therein, so that the water's edge cuts the upper part

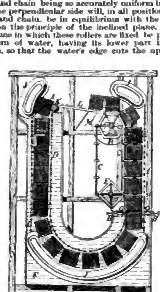


FIG. 27.

of the rollers, then, if the weight and quantity of the endless chain be duly proportioned to the thickness and breadth of the band of sponge, the band and chain will, on the water in the cistern being brought to the proper level, begin to move round the rollers in the direction of the arrow, by the force of capillary attraction, and will continue so to move.

On the perpendicular side of the triangle, the weights hanging perpendicularly alongside the band of sponge, the band is not compressed by them; and its pores being left open, the water, at the point where the band meets its surface, will rise to a certain height above its level, and thereby create a load, which load will not exist on the ascending side, because on this side the chain of weights compresses the band at the water's edge, and squeezes out any water that may have previously accumulated in it; so that the band rises in a dry state, the weight of the chain having been so proportioned to the breadth and thickness of the band as to be sufficient to produce this effect. The load, therefore, on the descending side, not being opposed by any similar load on the ascending side, and "the equilibrium of the other parts not being disturbed by the alternate expansion and compression of the sponge," the band will begin to move in the direction; and as it moves downward the accumulation of water will continue to rise, and thereby carry on a constant motion, provided the load be sufficient to overcome the friction on the rollers.

Now, to ascertain the quantity of this load in any particular machine, it must be stated that it is found by experiment that the water will rise in a fine sponge about an inch above its level; if, therefore, the band and sponge be one foot thick and six feet broad, the area of its horizontal section in contact with the water would be 864 square inches, and the weight of the accumulation of water raised by the capillary attraction being one inch rise upon 864 square inches, would be 30 lb., which, it is conceived, would be much more than equivalent to the friction of the rollers.

Now, the fallacy in this plausible argument is found in the words quoted. The equilibrium of the parts of the chain is disturbed at the moment the chain moves downward to compress the ascending file of sponges, and just enough disturbed to counterbalance the increase of weight on the perpendicular side. It is

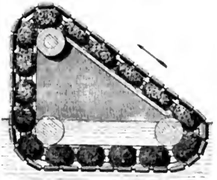


FIG. 28.

somewhat astonishing that a man of Sir William Congreve's ability should not have seen this at once, and still more astonishing that he should have disputed it when pointed out to him, which he did vehemently. Writing upon this subject, he says:

"For my own part, not being able to see any reason why the machine should not act, I confess that my faith is sufficiently strong to have induced me to take out a patent, and I am determined to use my best exertions to give mankind the benefit of this discovery, should it turn out, as I sincerely believe it will, a source of perpetual power without expense."

(To be continued.)

RAILWAY BUILDING IN THE NUBIAN DESERT.

A CORRESPONDENT of the London Times, writing from Wady Halfa on August 26, says that the railway between Wady Halfa and Abu Hamed, now in course of construction, is, from several points of view, one of the most interesting military lines in the world. For one thing, it crosses a portion of the Nubian desert which has apparently never before been trodden by the feet of man. In one place, however, it runs across what seems to have been the route taken a long time ago by a large body of men; for here, 60 miles from the nearest water, the engineers came across a mysterious collection of many hundreds of broken zeers, or earthen water coolers; they were two-handled, graceful amphoræ of a shape unknown in modern Egypt. This discovery naturally started a good deal of conjecture. Some remembered that Cambyses sent an army across this desert; then, to come down to more modern times, Ismail Pasha once dispatched a force of 2,000 men to Abu Hamed, which entirely disappeared in the desert and was never heard of again. Said Pasha, too, traveled in luxurious state to Abu Hamed in a carriage drawn by eight camels, with an army watering the desert in front of him to keep down the dust. The Cambyses theory as to the origin of these zeers is at present the most favored, as carrying us back to a respectable antiquity. There is yet another and a not unlikely explanation. There are numerous traces of ancient gold diggings in this desert. Do these broken vessels mark the spot where these diggers of old, of whom the Arabs have preserved no traditions, had one of their mining camps?

Describing a trip to the end of the line, the writer continues: When darkness fell we were well out in the desert, and, therefore, in a far more pleasant climate than that of the Nile bank, with its damp heat. Here the air was dry, pure and deliciously cool; it became even cold before dawn; one often needs three blankets to cover one at night at the summit of the line; here, too, we escaped for a time the ever irritating Egyptian flies. Even the air of midocean is not more sweet and invigorating than that of the wind swept, open desert, where, say the Arabs, the only diseases are hunger and thirst. So healthy, indeed, is it here that out of the 2,000 men working hard day after day in the sun on the railway construction there are rarely more than 12 on the sick list; and accidents account for the majority of these cases. It is noticed, by the way, that the men put on this work, receiving as they do regular and wholesome rations, rapidly improve in physique, increasing in size and weight to a remarkable extent. They all, both yellow Egyptians and coal-black Soudanese, appeared to be in the best of spirits. These people have a great capacity for railway construction, and seem to thoroughly enjoy their work.

Of the cheery, ever-grinning Soudanese, numbers were dervishes but a few months since fighting against us; and some were still wearing the jibbehs or Mahdist uniforms from which the colored patches had been torn off. One black ex-dervish worthy of mention is Sould, the Soudanese jester of the camp, who can al-

ways raise a roar of laughter in the working gangs, and is of distinct service, keeping up the men's spirits as he does by his clever mimicry and queer tricks. A bugler in Hicks Pasha's ill-fated army, he was captured by the dervishes and taken to the Mahdi's camp at Omdurman. There he discovered that he could make his life easier by playing the buffoon, and he became the jester of Wad el Bishara, the famous emir who commanded the dervish forces that were opposed to us last year. He used to be called up to amuse his master's friends by giving imitations of the British officers with whom he had been brought into contact. Recaptured by us last year at the battle of Hafir, he now, when not employed in rail laying, keeps the camp in a roar by his close imitations of his former master Bishara and other dervish notables.

Another correspondent, writing from Debbeh, says that all along the river posts civil tribunals have been established. There is a great demand among the natives for English stuffs and hardware, but at present the whole retail commerce is in the hands of Greeks. Last winter small quantities of gum and ostrich feathers were brought from Dar Fur, and it appears that a great amount of such goods is stored ready for sale as soon as the routes are open for trade.

THE FIRST-CLASS TORPEDO BOAT INJENIERO HYATT.

Messrs. Yarrow & Company, of Poplar, London, have sent us the following particulars of the first-class torpedo boat Injeniero Hyatt, which was one of six seagoing first-class torpedo boats lately built for the Chilean government by that firm. These vessels are 152 ft. 6 in. in length by 15 ft. 3 in. beam, and carry an armament consisting of two torpedo tubes and three quick-firing guns. They have a bunker capacity sufficient to hold 40 tons of coal and their radius of action is about 2,500 knots at a 10 knot speed. Two of these six vessels have been riveted up and tried successfully on the measured mile at the estuary of the Thames (full particulars of the trial annexed). The remaining four boats are being shipped in pieces with a view to being put together and riveted up in Chile. The Injeniero Hyatt left Plymouth on the 28th of April and arrived at Talcahuano on the 28th of June, having made in every respect a successful passage out, although during part of her run she encountered very bad weather. On arrival she went through an official trial with success, and on the examination of the boilers and the machinery everything was found in perfect order and quite satisfactory to the Chilean authorities.

These first-class torpedo boats were provided with two of Yarrow's patent straight tube water tube boilers, of about 1,000 horse power each, and weighing, including water and fittings, 9 tons each. It may here be remarked that lengthened experience has shown that this type of water tube boiler has an economy of at least 10 per cent. greater than the locomotive boilers of equal power which were formerly used in vessels of this class, and owing to the complete absence of leaky tubes through bad stoking, it has been found that less skill is required in the management of this type of water tube boiler than was necessary with locomotive or return tube boilers, because if, through bad stoking, cold air gain access into the furnace, it does not produce any injurious result.

THE FIRST-CLASS TORPEDO BOAT INJENIERO HYATT.

OFFICIAL TRIAL OF THE SEAGOING TORPEDO BOAT INJENIERO HYATT—FEBRUARY 15, 1897.

Draught of water, 4 ft. 1½ in. aft, 2 ft. 7⅜ in. forward; mean draught, 3 ft. 4½ in. Load on trial, 27 tons. Propeller, 7 ft. 6 in. diameter.

During the three hours' full speed trial in the estuary of the Thames the following runs were made over the measured sea mile on the Maplins:

Number.	[illegible]	First Receiver.	Second Receiver.	Vacuum.	Air Pressure.	Revolutions per Minute.	Time.	Speed in Knots.	First Mean in Knots.	Second Mean in Knots.		Slip.
1	175 lb.	77 lb.	12 lb.	24 in.	1¼ in.	344	2' 31"	23·841	25·983	26·187		48
2	180 "	77 "	12 "	24 "	1¾ "	345	2' 8"	28·125	26·391			
3	185 "	80 "	14 "	24 "	1½ "	350	2' 26"	24·657				
4	190 "	84 "	14½ "	24 "	1 "	363	2' 5"	28·800	27·257	27·232	27·219	38
5	190 "	84 "	14½ "	24 "	1¼ "	360	2' 20"	25·714	27·207	27·207		
6	190 "	84 "	14½ "	24 "	1¾ "	364	2' 5⅛"	28·700	27·207			
7	200 "	86 "	15 "	24 "	1½ "	363	2' 20"	25·714				

Mean revolutions per minute during three hours, 353·4, equal to 26·8 average speed in knots.

After the three hours' speed trial, circles were turned to starboard and to port in a space equal to about three times the length of the vessel. No trouble was experienced with either engines or boilers.

STEAM POWER IN THE FISHING BUSINESS IN EUROPE.

By Charles Theodore Mason.

The use of steam in the fishing business, says Mr. Georges Roche, in an exhaustive article on the subject in a Paris magazine, permits the regulating of the work at sea, while, at the same time, it assures the product of this work being delivered on land in good condition and in the shortest space of time possible. It also gives more security in the navigation, often difficult, of the fishing boats, and lessens the fatigue of the crew, so far as the handling of the tackle is concerned.

Steam is employed on board these boats either for the propulsion of the boats themselves and the handling of the tackle, the handling of the tackle alone, or for taking the product of the work to land. Steam fishing boats are utilized for the capture of fish with deep sea lines, with drag nets, or, as in the case of herrings and mackerels, with floating nets. Compactly built, more with a view to remaining at sea in all weathers than to furnishing them with a speed that they hardly need, these boats generally remain away from land for several days, in some cases even weeks, fishing in company and relieving each other in the task of taking the fish they have all caught to land. Many small tugs or coasters, and even yachts have been transformed into fishing boats, but at present steamboats are expressly built for the purpose.

The characteristics of a good type of steam trawler were given, in 1889, in the Revue Technique de l'Exposition Internationale. The boats referred to were built by an amateur of Dieppe and were intended only for work in the English Channel, but boats of this class must vary in form and construction according to the marine regions in which they are called to fish. The characteristics are as follows: Length between perpendiculars, 70 ft.; breadth, 18 ft.; depth, 8 ft.; draught, 6 ft., and the horse power 100. The speed of such boats was set down at nine knots an hour.

The characteristics of a Scotch steam trawler were given in a Bulletin of the Society for the Technical and Professional Teaching of Maritime Fishing, by Mr. P. Dunbar. The length of this boat was 120 ft., its breadth, 33 ft., its draught, 11 ft.; and the indicated power of its machinery, 500 horse power. The common type of these fishing boats doing a similar work is, however, only 100 ft. in length, with an indicated horse power of 300. The net cost of a steam trawler is from $16,000 to $19,000, but smaller ones may be had for $13,000. A sailing trawler furnished with a steam apparatus for hauling in the seine can be bought at Boulogne for about $5,000, but the herring and mackerel smacks, being of a greater tonnage, cost from $5,500 to $7,500.

In France, the ports equipped with steam fishing boats are fairly numerous. Of these, Boulogne supplies 3 large trawlers and 22 smaller ones; Dieppe, 73 of the first and 11 of the latter. Boulogne has also 200 sailing boats equipped with steam haulers, and Fécamp some 40 or more. Some of these last practice trawling in the Channel and in the North Sea, but the majority are engaged in mackerel catching in the Irish Sea, and, during the season for it, herring catching in the North Sea. Some years ago, fishing with steam was started at Trouville, but failed dismally, not, however, on account of any insufficiency in the production of the finny tribe. Between Fécamp and Arcachon there is at present only one boat equipped with steam haulers. Arcachon supplies 8 such boats (five of which belong to the Société des Pêcheries de l'Océan), while S. Jean de Luz supplies 3.

On the coasts of Great Britain there are more than 300 steamboats built of iron, 32 of steel, and 60 of wood, engaged in trawling in the North Sea alone. Some of these are provided with vivaries for carrying the fish alive to land. This large number is still increasing, but on the east coast only, for the boats of this class hardly amount to more than 20 on the west coast. In addition to these steamboats, the English fisheries employ a considerable number of sailing vessels equipped with steam apparatuses for taking in the seine, these vessels being kept in communication with the neighboring ports by means of steamboats, plying constantly to and fro from the fleet. These boats work in company, and in the vicinity of the North Sea banks. As soon as the fish are captured they are put, with small lumps of ice, in boxes specially constructed for the purpose, and in such a manner as to be easily handled. The steamboats, above alluded to, collect these boxes, after delivering whatever provisions, etc., they may have brought with them for the fleet. . . . The boats that work in company engage to remain at sea for two, three, and four months at a time. At Yarmouth, 700 of these sailing craft are employed, summer and winter, in this kind of industry; at Hull, 300 sailing vessels fish in company, and at Grimsby a like number are employed. It was Messrs. Hewett & Company, of London, who, in equipping a large fleet of trawlers, organized the first system of rapid transportation of fish to the various markets along the coast. The boats were then large sailing vessels; but, in 1864, the firm decided to equip steamboats for the purpose. It was not until 1880 that the adoption of these steamboats took place at Hull. The chief ports of Great Britain equipped with these steam craft are Aberdeen, Granton, Leith, North Shields, Sunderland, Hull and Grimsby.

In Germany, in 1884, a fish merchant of Geestemunde on the embrasure of the Weser, equipped the first steamboats for deep sea fishing. In 1889, 25 of these boats were employed on the west banks of the North Sea and in the neighborhood of Norway. To-day this number has increased to 100, working between Hamburg, Geestemunde, Bremen, Emsden, and Lubeck. Some of these are occupied in catching herrings with nets, others with lines, and the rest with trawling nets. In Germany deep sea fishing is an object of solicitude on the part of the government as well as of private societies. Hence it is that in the comparatively short space of 15 years a very important industry has been built up by Germany in the North Sea. In some of the markets where the French have been in the habit of selling a large quantity of salted fish the German fisheries have established a connection that threatens to drive the former out of the business, so far, at least, as these markets are concerned. Holland and Scotland have also begun to feel the effects of German competition.

The Emperor has founded a prize intended as a recompense to the designer and builder of the best model steam fishing boat, and a second prize is to be given to the person who designs the best sailing boat provided with mechanical hauliers. Both designs must be studied with a view to economy and simplicity.

In Holland the number of steamboats engaged in deep sea fishing is considerable, and mention must not be forgotten of the ostreiculture of East Escaut, which employs steamboats for the exploitation of the territory conceded it. Moreover, in the lower part of the Rhine and the Meuse, the seines are worked by means of steam apparatus, with the view to capturing the salmon which abound in these rivers, and of which some 60,000 are annually taken.

In Spain of late years a flourishing enterprise in the fishing industry has been established. At Vigo some 40 steamboats are engaged on the rocky banks which skirt the coast in this direction; while some 20 of a larger build, and worked by steam, practice trawling in the Bay of Biscay, coming sometimes as far north as the mouth of the Gironde.

To be successfully practiced, steam fishing requires a considerable outlay of capital. Hence, in England it is practiced only by large companies; while in France, Spain and Germany amateurs or private fishermen mainly interest themselves in it. Nevertheless, in certain ports, as at Groix, in France, the sailing trawlers are owned by a company of fishermen. Not long since, in the west of France, where steam fishing has only been known for some twenty years, a trawler from the Gulf of Gascogne returned, after an absence of twelve days, with a cargo that was sold for 4,000 francs ($800). A Grimsby fishing boat has also brought back to land, as the result of fourteen days' fishing, a cargo worth 545 pounds sterling ($2,725), while, in 1894, a steam trawler from Geestemunde made a haul, during Easter week, that was sold for 14,000 francs ($2,625).

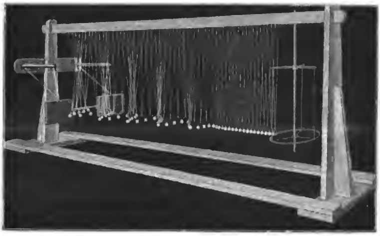
In France boats provided with vivaries are only used for the transportation of lobsters and crayfish. In England, Holland, Denmark, Norway and Germany these boats, however, are in constant use, much attention being paid in these countries to this means of preserving the fish alive. Fish thus taken alive to the markets enjoy a much greater favor in the eyes of the public than fish preserved in ice. These vivaries are either a part of the boat itself or else are large movable basins attached to its side. In either case, the water is renewed by the progress of the boat, the liquid being communicated to the deck by means of a kind of well in which the action of the swell is felt. A large number of the French fisheries still continue to make use of ice only as a means of taking the fish alive overland. The Société des Pêcheries de l'Océan, for instance, has organized the work in such a manner that the products of the trawling fleet (some five in number) are taken ashore every day by one of the boats, ice being employed only in transit by rail inland.

In the interests of the preservation of the product which they collect, it is to the advantage of the fisheries to employ steamboats as well as to equip the sailing boats with mechanical haulers. It is not enough that the fish be kept for as short a time as possible in ice; it is also necessary that they remain for as brief a period of time as possible under the water after they have

been captured. Moreover, when the tackle is drawn on board by hand, the fatigue occasioned by the operation is such that the work can hardly be performed more than a limited number of times a day. Hence a mechanical hauler would render the greatest possible service to every trawler that has not yet adopted it, while the resultant gain in money would be considerable.

A HERTZ WAVE MODEL.*

IN the spring of the present year I showed, at a meeting of the Physical Society, of London, a wave motion model which I designed to illustrate mechanically the propagation of a transverse wave. As the exhibition of this model on that occasion, and subsequently at the Royal Society and Royal Institution, has elicited a number of inquiries about the apparatus, it is thought that the following brief account of it may be of some interest to lecturers on physics, particularly at a time when the propagation of electric waves through space is occupying much attention. The apparatus, which is depicted in the accompanying cut, is mounted on a strong wooden frame about two meters long. At one end (the further in the cut) is the "oscillator," a heavy mass of brass hung by two strong V cords from arms which project parallel to the longer dimension of the frame. This mass, which, for the sake of analogy, is quite unnecessarily shaped to imitate an orthodox electric oscillator, can therefore be set swinging in a transverse direction by a suitable impulse given by hand. At the other end of the frame (the nearer in the cut) is the "resonator," a circle of brass wire hung by a tri-filar suspension. Oscillator and resonator must be adjusted by shortening or lengthening the cords so as to have identical periods of oscillation. The real problem in the construction of the apparatus was to find a mechanical means of transmitting the energy of the oscillator in visible waves to the resonator. The means finally adopted was a series of inter-connected pendulums on a plan somewhat similar to one suggested† in 1877 by Prof. Osborne Reynolds. Instead of using springs, however, the requisite inter-connection is obtained by simply suspending the leaden bullets which act as pendulum bobs by V suspensions which overlap, and which, as shown in the cut, are tied together at a point about four centimeters above each of the balls. No ball can be laterally displaced without tending to drag its neighbor also; so that a shearing stress is transmitted along the line of balls. As Reynolds showed twenty years ago, the velocity of propagation of the wave front differs from that of the group of waves, owing to the continual dying away of the amplitude of the advancing waves. This effect, due to the inertia of the medium, is of course equivalent to the presence of dispersion in the medium, waves of different frequencies being propagated with slightly different velocities. So far, therefore, as Prof. Fitzgerald remarked when the model was exhibited, it illustrates the propagation of the wave in a refracting medium rather than in the ether of space. The waves in the model travel quite slowly; and there is a fascination in watching their progress along the row of balls, until they arrive at the resonator and set it into responsive vibration. There is, of course, no attempt made here to represent the magnetic part of the electromagnetic wave at right angles to the electrostatic part; the mechanical displacements in the model corresponding to the electrostatic displacements of the Hertzian wave. A row of inter-connected pendulums such as this affords a means of illustrating many points in physics. For many purposes the elaborate system of suspension by strings may be replaced by a continuous fabric. Thus, for example, a piece of netting, hung on hooks from a horizontal rail, and ending below in a short fringe, with leaden beads on the fringe tips, will also serve to illustrate the propagation of a transverse wave. The structure adopted absolutely refuses to transmit longitudinal disturbances; there being no compressional elasticity between the balls to propagate a longitudinal wave.



MECHANICAL MODEL ILLUSTRATING PROPAGATION OF A HERTZ WAVE.

DIRECT PHOTO-LITHOGRAPHY ON STONE.

IT is rarely attempted to print direct on to the stone, although all the earliest experimenters in the process directed their efforts to this end. It is admitted that there would be considerable gain in a direct print, the loss of sharpness and delicacy by transfer even under the best conditions being sufficiently obvious, but most workers who attempt direct work appear to find the difficulties too great, and fall back on the easier method of paper transfers. Yet it is very probable that, like many other old processes of great practical merit, direct photo-lithography fell into desuetude because those who tried to work it lacked the necessary patience to master the details and conquer the difficulties which always crop up in working a new process.

Recently the writer was led to try a method of direct printing on stone, and found it far from being so difficult as it had been represented, and after two or three attempts a really good print was obtained, possessing a sharpness which could not be got with any transfer method. Afterward the process became comparatively easy as practice was gained. There are many lithographic firms which would be only too glad to find a man who can print direct on stone, and a study of this process may be recommended to young photographers who do not see any very rosy prospect in the present position of portrait photography.

The process we used was based on the published method of Poitevin, but modified as we shall describe. It will be best first to quote the original description, or rather a translated version of it.

Poitevin says: "A hard and close grained Bavarian lithographic stone is to be preferred. The surface being smoothed and finely grained, I wet it, and having removed the excess of water, I apply with a brush the bichromate mixture, composed of an egg beaten up, passed through a piece of linen, and mixed with an equal quantity of saturated solution of bichromate of ammonia. With a sponge I clean the edges of the stone, and with a linen dabber I remove the excess of solution by dabbing, but without rubbing, and with a drier cloth I remove the remainder of the liquid in the same way until the stone no longer moistens the finger when touched. By working thus, only a very small quantity of the bichromated mixture penetrates into the stone and forms there a very regular inner layer without covering its surface. Without waiting for the complete drying of this layer, I apply to it the photographic cliché, if of paper, by keeping it in place by means of a glass plate fastened down by means of pellets of soft modelling wax. I have also used a special pressure frame to hold the stone and negative, but the way I have described answers ordinarily. If the negative is on glass, I fix it with wax. I expose the prepared stone either to direct sunlight, falling perpendicularly on its surface, or to diffused, laying the stone horizontally. The time of exposure is very variable in summer (from ten to twelve minutes in the sun), and in winter from an hour and a half to two hours; in the shade the exposure will be from four to five times longer. In any case the latitude is great, and it is better to expose too much than too little, because over exposure can be corrected in the inking of the stone and by the etching and proving, while too little exposure prevents the greasy ink from adhering to the half tones, and that cannot be remedied.

"After exposure to light the stone is taken into the inking room, and there left for some time to take the temperature of the surrounding air, whether it may have been too much warmed or chilled, according to the temperature of the time of year.

"The stone is moistened with a sponge dipped in a solution containing one-third of glycerine to two-thirds of water, and having removed the excess of liquid, I pass a roller charged with transfer ink and varnish all over the stone. The image then appears gradually, the parts which have received the action of light retaining the fatty ink, while the others, corresponding to the whites of the drawing or opaque parts of the negatives, repel it. The stone is damped lightly with ordinary water, and the inking is continued until the drawing has attained the desired strength. If the stone should have been over-inked, the whole is removed with turpentine, the stone is wiped and damped, and the inking-in is done again more carefully with the roller less charged with ink.

"The stone is then left at rest for about twelve hours, in order that the fatty ink may penetrate it and be fixed more completely. It is then gummed. After an hour it is washed, the gum removed, and the stone is then rolled in with ordinary printing ink, etched and proved by pulling a few proofs, just as in the case of an ordinary chalk drawing on stone.

"If the exposure to light has been insufficient, the fatty ink will take with difficulty and the proof will be wanting in half tone; on the contrary, if over-exposed, the image will be heavy and blocked up, but in the majority of cases a good proof is obtained, because there is a great latitude in the exposure if the lithographer is skillful in working up the image. In any case it will always be better to expose a fresh tone rather than to hand over a bad impression to the printer."

It must be noticed that Poitevin is here describing a method of half-tone transfer, and for this reason he speaks of the surface of the stone being finely grained. For a line engraving, or a print from a half-tone negative made with the ruled screen, the smoother the stone is the better, and therefore the polish should be the highest it is possible to obtain, and care should be taken that the stone has been ground quite flat. Any hollows will give trouble. The quality of the stone is of importance, and it should be for preference that rather scarce kind, the gray stone. The yellow stones can be used, but not so easily. The surface of the stone should, of course, be scrupulously clean. Any finger marks would leave a greasy stain which would attract the ink. In coating the stone as described, there would be a difficulty in getting an even film, and the writer prefers to warm the stone in front of a good fire until all the moisture is driven away from the surface of the stone, which then becomes quite warm. The sensitizing solution, exactly the same as used for zinc, is flowed on and spread with a glass rod if it does not flow well.

It is best not to allow any solution to go over the edge of the stone, as it has a tendency to creep back, bringing dust and grit with it, and setting in dirty ridges. The warmth in the stone quickly dries the film, and when quite dry it is ready for exposure. Small stones can be screwed up in a specially made deep printing frame with plate glass front. There is not so much risk of breaking the negative as might be supposed. Poitevin's method of attaching the negative to the stone with pellets of wax is a convenient way, provided the negative glass is flat and the exposure made inside a deep box with blackened sides, so that the light falls perpendicularly.

A better plan is to use stripped film negatives, squeezing them into contact with the stone after having given the latter a light coating of castor oil or vaseline applied on top of the sensitive coating by means of a gelatine roller. The film will then adhere very firmly to the surface; the oil or grease does no harm, as it mingles with the ink when the rolling up comes. The printing does not take so long as Poitevin says. It is, in fact, pretty much the same as for zinc—about three minutes in good sunlight and from fifteen to thirty minutes in diffused light or shade. The temperature of the stone while being inked is quite as important as Poitevin points out. The ink used should be "stone to stone retransfer," applied with a leather roller as stiff as it can be worked. It must be well distributed, and the most delicate coating applied to the stone. Anything like blackness must be avoided; it will simply be an olive gray tint. Then the water from tap or hose pipe is allowed to run over the stone for some minutes, and an indistinct image will be seen. With cotton wool on a soft sponge the surface is gently rubbed until the ink is loosened and comes away. Eventually, if the exposure and other conditions have been correct, a beautifully sharp and black print on the stone will be secured. This is dusted over with very fine resin, and etched with acidulated water, about vinegar strength, after which it is gummed and rolled up in the usual way familiar to all lithographers. The result should be a print very much superior to transferred work, and it will retain its sharpness even during a very long run on the machine. The only drawback is the weight of large stones and the difficulty of handling them in the dark room, but the process has a wide application with small subjects, for which the stones are comparatively light.—Photography.

ON PRACTICALLY AVAILABLE PROCESSES FOR SOLDERING ALUMINUM IN THE LABORATORY.*

IT seems that, ever since the metal aluminum has been used in construction, difficulties have arisen in soldering it. Further, from contemporary literature it appears probable that some perfectly satisfactory methods of getting over the difficulty are known, but not published in sufficient detail to be available.

Hence it seems well to put on record any advance toward the solution of this somewhat troublesome problem. In the first place, my experience is that it is not easy to solder aluminum simply by using an alloy of definite composition without a flux. Also that the only other process which does not require special apparatus, that based upon the use of silver chloride, is very troublesome indeed unless the local fusion of the aluminum be immaterial. I find, however, that cadmium iodide is distinctly more satisfactory. If it be fused on an aluminum plate, decomposition of the salt occurs long before the melting point of the aluminum is reached. The result is generally the violent evolution of iodine vapor and formation of an alloy of cadmium and aluminum on the surface of the metal.

The decomposition of the cadmium iodide is, however, too rapid to be convenient, and the pulverulent white residue is in the way. It is, therefore, of advantage to add some other body which, if possible, will obviate these defects. I find that zinc chloride answers fairly well. Thus I mix concentrated zinc chloride solution with a little ammonium chloride, evaporate in a round porcelain dish, and ignite at a low red heat till a part of the ammonium chloride is volatilized. The fused chlorides are now mixed with cadmium iodide. The proportions of zinc chloride and cadmium iodide are best adjusted experimentally.

The final result, when the salts are completely fused together, is a flux which readily enables tin (or other soldering alloy) to unite perfectly with aluminum. The melted flux can be taken up in a pipette with India rubber teat, and dropped on to the surface of the metal to be soldered. Some powdered metallic tin is also sprinkled on the surface. The aluminum is then heated over the Bunsen flame till the flux just melts; it can then be quickly spread where it is wanted with a piece of copper wire or thin glass rod. As the temperature is farther raised the flux decomposes, and the tin readily alloys itself with the surface of the aluminum; while the flux is decomposing, the tin can be spread in a continuous layer by means of the little glass rod or wire.

Instead of cadmium iodide, fused lead chloride may be used in a similar manner.

I should like to substitute some of the less volatile alkyl-ammonium chlorides for the ammonium chloride, but have not had opportunity.

* Silvanus P. Thompson, in Nature.

† See Nature, vol. xvi., p. 343.

* By A. T. Stanton, in Nature.

ENGINEERING NOTES.

Seagoing barges of large capacity are coming into use at Hamburg since the opening of the Baltic-North Sea Canal.

The system of locomotion by machinery is now superseding that of traction by horses, not only in tramway service, but for omnibuses. The Berlin omnibus company is introducing for trial omnibuses propelled by electricity from a secondary battery. The charge is renewed at the two terminal stations.—Uhland's Wochenschrift.

There are in Sweden at the present time 146 furnaces in blast. The production of pig iron, the bulk of which is smelted with charcoal, amounts to 462,930 tons per annum, which represents a daily production of 12·8 tons per furnace. According to The Iron and Coal Trades Review, in 1895 there were in the country 30 Bessemer converters, 33 open hearth furnaces, and 5 crucible steel furnaces.

Statistics show that the number of German and English vessels passing through the Suez Canal is approximately in the same proportion as the size of the corresponding fleets, namely, 1:7. The canal was opened in 1869; in 1870, 486 ships passed through it, in 1896 this number had increased to 3,409. The corresponding increase in tonnage is, however, much greater, the first year's total being 655,000, and that for 1896 being some twenty times as much, namely, 12,000,000. The greatest ships that pass through the canal are the German mail steamers of the East Asiatic Line.—Uhland's Wochenschrift.

The use of acetylene for driving engines is, according to Revue Industrielle, entirely possible, as shown by a series of experiments conducted at Compiegne by Cuinat. It was shown that acetylene develops fully three times the energy of the usual illuminating gas and that the only changes needed to transform an ordinary gas engine into an acetylene engine was a reduction in size of the intake valves. The best mixture was found to be 10 of air to 1 of gas. With these proportions it was found that engines ranging from 8 to 16 h. p. cost about 6 cents per h. p. hour, at the present rate of calcium carbide.

The first cargo of molasses to be sent across the Atlantic Ocean in bulk from this country, it is stated, will be that taken out from Philadelphia by the British tank steamer Petriana. She has been chartered by parties in New York to carry about 600,000 gallons of sirup molasses, which have been purchased from the sugar trust. The port at which the cargo will be landed is London. A great deal of money can be saved, it is said, by shipping it in this way. The cost of cooperage, etc., will be saved, as it will be necessary only to pump the liquid into the vessel's tanks.—Philadelphia Ledger, September 18.

The pipe mills of the Reading Iron Company, probably the largest concern in the United States making black and galvanized iron pipes, have commenced running day and night. One million pounds of pipe, ranging in size from one-eighth of an inch to twelve inches in diameter, are turned out each twenty-four hours. Recently there has been a great influx of foreign orders, and the mills will be kept busy for some time to come making pipe for export to Australia, Africa, England, various countries in the European Continent, Mexico and India. Ten carloads of pipe were consigned to Singapore recently and much more is to follow.

At Toulon the French battleships Brennus, Neptune and Marceau have been engaged in target practice against the hull of the old dispatch boat Pétrel, which was towed with a couple of sails hoisted by the Travailleur, while the Linois, in a position perpendicular to the line of fire, observed the results. She had on board several officers of the squadron as a committee to report, says The Army and Navy Journal. The Brennus discharged twelve rounds from her 13·3 inch guns and eighty from the 6·2 inch guns, the Neptune 100 rounds from her 12·5 inch gun, and the Marceau six rounds from the large guns and 160 from the 5·5 inch quick firers. Thus in all, 298 rounds were discharged at the vessel and at certain targets which were in tow. Very often the shells fell short, but there were many hits, and some of the projectiles went through the boat without causing any serious damage. Others, however, spread destruction where they fell, and the above-water portions on the port side were almost demolished, while there were some hits below the water line. It was observed, however, that few shells struck the Pétrel between wind and water, but this was accounted for by the great range. The dispatch vessel did not sink, notwithstanding the battering that was given her, but was towed back to Toulon for examination and to be fitted for some further trials toward the end of the month.

We are quite accustomed to see iron or steel arched bridges hinged at the crown and abutments, but to treat a masonry arch in this manner would at first sight appear to be rather venturesome. In Germany, however, several bridges were built some few years ago on this principle, one of them having an effective span of 150 ft., and the result has been quite successful, both from a constructional and from an economical point of view. A complete description of this method of construction was contributed by Mons. G. La Riviere to the Annales des Ponts et Chaussées soon after the bridges were built, and is well worthy of careful perusal. The author draws attention to several curious features in the design of these bridges, but by far the most remarkable is the introduction of the three joints in the masonry ring. These joints, which really act as hinges, are placed one at the crown and one at each abutment, and prevent, of course, the line of pressure deviating very much from the center line of the arch ring, thereby removing all ambiguity as to the actual stresses. The rise of the arches in some cases is not more than 1/10 the span, and no masonry backing is employed, the roadway being supported from the arch by means of thin spandrel or cross walls. The hinged joints are made by inserting sheet lead about 1/8 in. thick, extending over only the middle third of the arch stone. At first it was thought that this joint should be made by means of bearing plates and pins, much in the same way as would be done in a steel arch, but this arrangement was subsequently abandoned in favor of the sheet lead.

ELECTRICAL NOTES.

The last horse car line has lately been abolished in Stuttgart (Germany) and electric cars have been substituted. With this all street cars in Stuttgart are now electrically propelled.—Electrotechnische Rundschau.

Suspended railways offer several advantages over the ordinary style of cars. They are less noisy, occupy less space, and have a very gentle motion, which is agreeable to the passengers. Such a line is to be constructed from Dresden (Germany) to the surrounding country; cars are to run every two or three minutes, at a rate of 25 to 30 miles per hour, or, if the stoppages are taken into account, at about 14 to 18 miles per hour.—Electrotechnische Rundschau.

The effect of moisture and heat on electricity insulators is dealt with in a paper read at the recent meeting of electricians at Eliot. In the discussion that followed the reading, Prof. Perrine states that more than 4 per cent. of the total weight of a No. 18 copper cable, covered with paper 0·128 in. thick, can be driven off by evaporating the moisture it contains. Even in dry climates, like that of California, 15 per cent. of the weight of such a paper sheathing is due to moisture. Some specimens of wood were shown which, after being thoroughly dried, had, in three days, added 15 per cent. to their weight by absorbing moisture from the air. Cellulose compounds are unstable at ordinary temperatures, but at 100° they slowly carbonize and fast deteriorate in insulating value.

In the Journal of the Society of Chemical Industry, M. Andreoli remarks that, though theoretically one should be able to produce a kilo of ozone per electric horse power, in practice only ten or twelve grammes are obtained. By improvements, however, in apparatus for the production of ozone, M. Andreoli is now able, he contends, to increase the amount to thirty and in some cases even fifty grammes per horse power, making the cost about 75 cents a kilo. This, if a practical thing applicable on a large scale, is important. Based on these results, experiments are to be made by him in various directions, to ascertain the value of the process in commercial affairs, such as the purification of drinking water, the cleansing of beer casks, preparing wood for instruments and furniture, bleaching of starch and dextrin, oxidation of drying oils, purification of wine and brandy, etc.

According to L'Eclairage Electrique, the Sussmann electric miner's lamp was recently tried in Belgium, and gave very satisfactory results. The accumulator used is one containing a solid electrolyte. An incandescent lamp is fixed above the accumulator, and is inclosed in a special case; the ebonite box, measuring 5 in. by 3½ in. by 2¾ in., is divided into two compartments, each of which holds two negative plates and one positive, which are separated by rubber bands. These plates are pasted; the two cells are connected in series, and give an electromotive force of about 4 volts. The lamp, complete and ready for use, is somewhat heavier than the ordinary miners' lamp, its weight being 4·3 lb., and its capacity 12 to 26 hours, burning under normal conditions, the light given being from two and a half to five times that of an ordinary miners' lamp. The power required for charging was found to be about 3¼ horse power per 100 lamps.

About the surest beacon of prosperity is a sawmill, and when we find one like this at Port Blakely, Wash., than which there is but one other larger in the world and none bigger in the United States, we are inclined to stop to regard it. The whole plant is lighted by electricity, and at present the mill is running night and day, with three shifts of men for the twenty-four hours. Electricity is also used for motive power in the planing and finishing departments and in the blacksmith and pattern shops. Their lathes, planes, moulding, and pattern workings are so complete that they are enabled to supply any portion of disabled machinery at short notice, and last year furnished fifty tons of castings for their own repairs. The company also owns and runs a gristmill for a supply of the logging camps, a hotel for visitors, a hall for public meetings and church purposes, and a town of some 200 houses. Their general store carries a stock complete in every line, from a package of pins to the largest hawsers and cables.

The Antwerp correspondent of The Liverpool Journal of Commerce says that for some time there has been a desire expressed that the electric light should be used for loading and unloading vessels at night, owing to the many serious fires which have taken place at frequent intervals from the upsetting of the old fashioned oil lamps, which have been used since time immemorial. The first experiments with this object in view took place at dock No. 5, five arc lamps being used to light up the quay. When work is not going on, the lamps are hung on arms connected with the cranes; but when a vessel is being worked after dark, the lamps are carried about and hung at points where they can throw the most light into the hold, thus enabling the men to work as in broad daylight, and the custom house officials and tally men take their notes with perfect ease. The danger of fire is reduced to a minimum, and thieving will be less. It is hoped that after this experiment, which has proved so successful, the entire quay system will be furnished with these portable arc lamps.

A very successful and beautiful trial demonstration of the lighting by electricity of the whirlpool rapids of Niagara Falls was given recently, says The Electrical Review, during the conventions in that city and greatly pleased every observer. Special parties of ladies and gentlemen took the Gorge route cars, accompanied by a flat construction car carrying the searchlights and appliances. Current was taken from the trolley wire, six searchlights being supplied, and magnificent color effects were produced on the surging waters by means of the usual color screens. Mr. Luther Stieringer originated the scheme, and through the liberal assistance given by Capt. J. M. Brinker, president of the Gorge road, and Superintendent J. K. Brooks the work was carried to a most successful issue. The apparatus was furnished for the occasion through the courtesy of the General Electric Company. Further private trials are in progress to determine the proper arrangement and quantity of light required to illuminate these rapids in the most effective manner. Numerous requests for the repetition of this novel lighting during the American Street Railway convention in October have been made, and, if possible, will be complied with.

MISCELLANEOUS NOTES.

To distinguish benzine from benzole, add some potassium iodide crystals. Benzole is colored red by this salt, while benzine remains unchanged. If benzole is shaken up with a little alcohol, it turns milky, while benzine does not.—La Science en Famille.

Of two lots of gold from the Klondike received at the New York Assay Office, says the Engineering and Mining Journal, one assayed 0·749 per cent. gold and 0·246 per cent. silver, which made the value $15.48 an ounce, while the other assayed 0·820¼ gold and 0·174 silver, making the value $16.95 an ounce.

L. Davy, in Comptes Rendus, cxxv, No. 8, says that all authors who have studied the ancient working of tin in the west of Europe admit that it was far anterior to the occupation of the country by the Romans, and think that the mines of Abbaretz-Nozay were abandoned by the Gauls about the date of the Roman invasion.

An arrangement by which more than one note may be obtained from a single bell is being made by Mr. Slnaber, of Reading, according to a patent granted to him. The device by which he gains this end consists merely of a number of dents, which divide the whole bell into several sections of different sizes. Each section, when struck, gives a note corresponding to its size.—Wiener Gewerbe Zeitung.

Of all postal service, that in East India is the most difficult. There are 4,000 packages monthly which do not reach their destination on account of not bearing any address. The multitude of Hindoo dialects is another great difficulty the postal officials have to contend with, and the postmen are exposed to considerable danger from wild beasts.—Uhland's Wochenschrift.

It is stated in Machinery that acetylene is now in use in several of the Paris omnibuses. The generator weighs about 20 lb., and is carried under the front steps. Each load of carbide is about 0·72 lb., and produces about 3 cubic feet of gas, which is enough for 6¼ hours, with a light of 16 candles. The pressure is regulated so as not to exceed 4 in. of water. The cost is less than that of petroleum. Electrical accumulators to do the same work weighed nearly 3 cwt., and did mischief, so that they were glad to give them up.

Herr Nebendahl, of Wandsbeck, Germany, has invented a device for the automatic lighting and extinguishing of street lamps. The working of this apparatus is based on the difference of the pressure at which the gas is supplied during the day and at night, and is so delicate that it is sufficient to have that difference equal to 7 millimeters of mercury. The device consists of a cup containing glycerine, into which dips an inverted bell. This bell is connected to a lever, and by a pipe to the gas conduit. When the pressure of the gas is low the bell is also at a low stand, and the lever admits the gas only to a small lighting flame. When the pressure is raised the bell rises, and the lever opens a cock to the main flame.—Uhland's Wochenschrift.

The management of the French State Railways has obtained the permission of the Minister of Railways for the construction and reconstruction of a number of railway passenger carriages, in which all the parts formerly manufactured of brass, copper and iron, with the exception of axles, wheels, bearings, and springs, brake beams and couplings, shall be constructed of aluminum. The weight of a carriage with aluminum fittings is one and a half tons less than that of an old style carriage. As an ordinary train in France consists of twenty coaches, the weight of the train could be reduced by thirty tons, which would mean a considerable saving in working expenses. It remains to be seen whether aluminum will prove to be as durable as the other metals for the purpose.

E. W. Parker, of the United States Geological Survey, has prepared a report showing in fifteen States the increasing use of coal mining machines from 1891 to 1896. In the former year the amount of coal mined by machines was 2,739,743 tons. This was 3·3 per cent. of the total amount of coal mined that year. Ohio mined 1,654,081 tons by machinery, or over 60 per cent. of the total machine mined coal. In 1896 these fifteen States mined by machinery 12,553,522 tons, which is 13 per cent. of the aggregate output of those States for the year. Ohio increased its machine mined coal from 1,654,081 to 8,308,349 tons, while Pennsylvania increased from 213,492 to 6,092,644 tons. The total output of the fifteen States increased 16 per cent. from 1891 to 1896. The machine mined coal increased 400 per cent. There is no reason to believe that the machines will not be still more widely adopted in the future, since their economy has been demonstrated. While the operation of the machines is easily acquired by a miner, their more general use will tend to increase the average intelligence and skill of the miner.

According to the Pittsburg Dispatch, the largest and most important contract for aluminum ever made has just been closed by the Pittsburg Reduction Company. The contract calls for the delivery in London to the British Aluminum Company of 1,080 tons of aluminum casting ingots at a price aggregating over $750,000. The largest previous contract was one of 80 tons, made some time ago with the German government. This makes Pittsburg the greatest producing center of aluminum in the world. According to the contract, the aluminum will be delivered at the rate of 25 tons per month for the first two years and 20 tons per month for the ensuing two years. The British Aluminum Company has been considered one of the greatest producers of aluminum in Europe, and the placing of such a large contract in the United States is looked upon as significant. The exporting of such great quantities is due to the ingenuity and enterprise of American manufacturers, and places this country at once in the lead of the world. President Alfred E. Hunt, of the Pittsburg Reduction Company, A. W. Mellon, a heavy stockholder in the concern, and J. O. Handy, the principal chemist, are now in Europe, supposedly in connection with the big contract. While the plant of the company is located at Niagara Falls, it is owned by Pittsburgers, and immense benefits are expected to accrue to that city. It is understood the largest part of this shipment of metal will be used for army utensils and buckles for the Russian army.

PRODUCTION OF STATUARY.

THE first thing to settle in a statue or group is the general design. For this purpose the artist, having chosen his subject, makes one or more sketches on paper, representing his conception of the treatment appropriate to it; these he will vary as improvements on the original idea suggest themselves, or as new notions spring up. Having to a certain extent satisfied himself with one or other of them, as expressing fully what he wishes, and as being at the same time harmonious in its arrangement, he then proceeds to make from it a small sketch or model in clay, in order to ascertain its probable effect in other views than the one represented on the paper. For it must be recollected that sculpture is widely different from its sister art, painting; the former has many views to consider, the latter has but one; and though in a piece of sculpture there will, of course, be principal views more effective than others, still they must all be agreeable, and to a certain extent suggestive or expressive of the main idea; and for this reason the sculptor has frequently to sacrifice or modify that which, were only one view to be considered, would aid him forcibly in his intentions. It is scarcely necessary to say, therefore, that alterations occur again in these clay sketches, and more than one is frequently made before the final decision on the question of design takes place. This done, the full size model is commenced in clay, the same material as the sketch, and for this the artist has to supply supports, as it rarely happens, except in recumbent figures, that the clay will hold itself together in the required position without their aid; no difficulty exists, however, in providing these, the roughest hedge carpentering answering the purpose better than the finest workmanship. All that has to be done is to build up upon the stool a rough woodwork of sufficient strength to bear the weight of the clay and prevent it sinking, and to so arrange it that it shall be contained within the surface of the proposed model. Upon this the clay is kneaded by the hand into the requisite form, unassisted by anything but a few very simple wooden tools that help to cut, scrape or press, as may be required. The clay itself is that prepared by the potters for the common white stoneware, and is in no way expensive. Young inexperienced artists often show an overstrong predilection for the use of these wooden spatulas, or modeling tools, as by their assistance they find they can more easily obtain a smooth surface to their work; but experience afterward teaches them that an imitation of the pulpy surface of the flesh can only be obtained from the touch of flesh itself, or, in other words, from the pressure of the finger and thumb, and that the wooden tools must be used sparingly, merely as assistants to the hand, otherwise a hard mechanical style is apt to creep in. There is in truth in a real artist, when working on his clay, the same species of feeling as in a fine pianoforte player, who draws expression from the instrument, not barely from correctness of note, but from a mental absorption in the music which imparts itself to his touch, and this affinity between head and hand is interrupted in the sculptor when the modeling tool intervenes between the surface of his work and the delicate sensation with which his hands are endowed.

With persons unacquainted with sculpture there is a general impression that the cutting of the marble is the most difficult part; but those who are intimate with the art know that the designing and modelling are the primary portions, and that the other, though of course requiring some knowledge as well as taste, is, in comparison, scarcely more than a clever manual dexterity. The artist, in fact, employs his own hand almost entirely on the designs and modeling, for in these stages he has to originate almost all the beauties of his work, and he knows if his model be in any way defective, inaccurate in its proportions or wanting in beauty or expression, that there is no hope that such defects will be remedied in the marble. The latter portion is indeed, in a measure, a mechanical process of copying, restricted, by the very means it employs, from departing to any great extent from the model. Before the model is finished nature must be referred to, and that frequently, to give an air of truth to the figure, which never was and never will be gained except by reference to her. We will, however, suppose that the sculptor has by dint of time and labor thoroughly studied his model, compared it with and corrected it from nature, arranged his draperies and subordinate parts in proper order, brought all the surfaces up to a necessary degree of smoothness, in fact, given to the best of his talent and power actual embodiment of that which his mind has conceived. It is still in the soft clay, which will not bear moving, nor be durable for long, as it is liable to shrinking, and if not constantly supplied with moisture would eventually crack, owing to the supports within not allowing every part to diminish in an equal degree. It has for this reason to be moulded and cast into plaster, a process we shall briefly describe. Plaster of Paris is a strong, fine, white lime, made from gypsum or alabaster ground to powder and baked; and, so prepared, has the property of crystallizing rapidly when mixed with water, or, in other words, of condensing itself into a hard body. A certain quantity is mixed with water, sufficient to form a liquid of about the consistency of good cream, and thrown over a portion of the model, walls of soft clay having been built round that portion in order to prevent it from running on the other parts. The object of thus covering a part only at a time will be seen presently, and the proper division of such parts must be learned by experience, as it depends entirely upon the peculiarities of the model. This liquid plaster of Paris will, under the hands of an experienced workman, take an exact impression of the surface, and in the course of a few minutes become hard, as we have before explained. More must be added, however, in order to render it of the thickness necessary to sustain itself, which thickness will depend on the size of the object to be moulded. The clay walls are then removed, when we have one-half or more of the model covered with a hard shell, the edges of which stand up clean and square from the clay. These edges are then soiled with clay water, and the same process goes on with the other half; or, if it be a very complicated work, there may perhaps be three, four, or even five pieces of mould, all made in this way in succession.

The whole having been covered, after this manner, with a coating, the inner surface of which has taken a delicate impression of every marking on the model, the next step is to open this shell or mould, in order to take out the clay. If the joints between the pieces have been well washed with clay water, these will separate easily by the driving in, at judicious distances, of a few wooden wedges. At any rate, one piece will come away by this means, and from the opening thus made we can pick out the clay, just as it will best come, only taking care not to injure the surface of the mould, as any damage done to that will show itself in the cast. The interior of the mould is now washed with a soft brush and water, and the pieces again put together and bound round with ropes to keep them to their places. The whole is well saturated with water, and fresh plaster of Paris of a finer quality poured into it through the mouth formed by the underneath side of the base. This also, becoming in a few minutes hard, forms a facsimile in plaster of the clay model, to be afterward extracted from the outer casing or mould. Between the surfaces of the two, however, there is but little adhesion, as the saturating the first with water previous to filling it with the second prevents it. The removing the outer coating is accomplished by chipping it off in small pieces by means of a mallet and blunt chisel. This part of the work requires considerable practice as well as caution to prevent injuring the cast; but if everything has been well managed, the pieces will splinter off before the edge of the chisel reaches it. To remedy at last any little faults or inaccuracies that may have occurred, rasps, glass paper, fish skin and for small work Dutch rush are used.

The working of the marble now begins, which, if it require not the highest talent, takes at least the longest time and the greatest labor. The model and marble are fastened in relative positions on two square blocks of stone, having each, along the edge in front, a scale of parts marked out, similar to those on a carpenter's rule. The "pointing instrument," as it is called, is then applied, which consists generally of an upright pole, with a cross piece attached, that travels along the edge so marked, just as a T-square travels along the edge of a drawing board. (This pointing instrument may indeed be well conceived by fancying a large T-square, the long part round instead of flat and perpendicular instead of horizontal.) To this is attached a circular metal bar, and at the end of that again a needle, with ball and socket joints between both. By the aid of these joints the workman can fix the point of the needle to any part of his model, and having by means of the screws tightened the joints, can transfer the instrument from the stone on which the model rests to the other, when of course the relative position of that part in the marble will be indicated if the instrument itself be fixed to the corresponding number on the scale. It is, in fact, nothing more than a system of finding a third point from two already given. Various improvements have from time to time been made on this instrument in order to gain facility of motion, but the principle in all is the same. The best one is, perhaps, that invented by Behnes, for which the Society of Arts awarded its gold medal. It possesses greater variety of movement than any other, and, as such, is more convenient to the workman, but has one drawback—a too great liability to get out of repair. Indeed, it will be easily understood that in an operation where dust and small pieces of marble are constantly flying about, it is not advisable to have to do with machinery of too delicate a construction. By this simple method the block is hewn out roughly, but correctly, into shape, and a great number of points or perforations are made in it, the bottom of which represent the surface of the model, and correspond in distance from each other with small pencil dots, marked at the time of taking them upon the model. These marks on marble and model form so many guides for the carver who now takes the work in hand, so that his mind is entirely relieved from the apprehension of any error in the main proportions or position of parts, these being definitely fixed by the points themselves. He has merely to copy what he sees correctly, by the aid of these points, and to bring the whole to a good fine surface; his ingenuity is displayed in clearing out with his chisel and hand drill the deep cuttings—often a very difficult task, attended not only with a great deal of labor, but requiring considerable skill as well as practice. The marble comes at last again into the artist's studio, from whence the model emanated; and his delight is then in giving those final touches which remove from it any hardness or immobility it may have acquired under the hands of a copier and impart to it the spirit and character of nature. The whole is ultimately rubbed over with sand and water by the aid of small pieces of wood and linen rags, to remove the dry, dusty appearance derived from the chisel or rasp and to bring up the lucid beauty of the material.

When the multiplying of casts is required, as is frequently the case, a mould is again made upon the finished marble, much after the fashion previously described with the clay, but composed of an immense number of pieces, fitting one within the other, so as to admit of each one coming away separately from the marble, and, again, from the casts, without injury to either.

This is professionally termed "safe moulding," on account of the outer coating being preserved; in opposition to the other, which is called "waste moulding," from the shell or mould being destroyed in the process. Any reasonable number of casts may be taken from the safe moulds.

Bronze casting is another distinct process, little understood by artists themselves, and requiring, moreover, considerable accommodation in the way of premises, furnaces, apparatus, etc. For these reasons it is frequently intrusted to regular trade founders, who understand well enough the moulding and melting of metals, but who cannot be expected to comprehend the niceties required in a good work of art. The consequence is, in this country at least, that considerable deterioration often takes place; the bronze casting representing but imperfectly the form of the original model. The practice in these ordinary foundries is to mould the parts of a statue in sand and loam, after the manner of common metal castings, and without doubt much expense is thereby saved; but the result is never quite satisfactory, as these materials are not fine enough to take a sharp expression, nor stable enough to retain it uninjured during the operation of building the core and pouring the metal, owing to which many parts of the mould have to be repaired by the workman, and accuracy to the model is lost. In engineer's work castings are all afterward made true by planing, turning, filing, etc., so that, provided they be sound, it is not positively necessary that they should be in every respect accurate. Not so with fine art bronzes. Chasing—in fact, all tool work on the metal—tends to destroy all freedom of manipulation, and to produce in its stead a stiff, mechanical style, the reverse of all semblance to flexibility. It is desirable, therefore, that a bronze statue should be cast from the mould as perfect as can be, and that it be subject as little as possible to the operation of the chaser's chisels and punches, though of course these must be brought into use, to a certain extent, as matters of necessity rather than choice.

Moulding for bronze requires frequently that the plaster model should be cut into parts. It rarely happens, in fact, that a statue or group can be cast in one piece, owing to difficulties that arise, first from the moulding itself, and secondly from the running of the metal into that mould. It will not be requisite to describe the moulding of these pieces, as the process is similar to that previously performed on the clay, with some modifications necessary to suit the nature of metals. There are, however, two or three points which require especial care and attention, and which regulate many of the contrivances adopted in it, and by alluding to these we shall at once enable the reader, aided by what has already been said, to understand the whole business. One of them is the necessity for fully providing for the free entrance of the liquid metal into the mould, as well as for the easy and perfect escape of the air out of it, as it becomes displaced by the metal; for, without proper arrangement for this there is not the slightest chance of the cast being sound, and explosions may take place, destructive not only of the work, but even of life itself. For this reason channels have to be made in the joints of the mould down which the metal is first made to run, whence, entering the vacancy left to form the cast at the lowest point, it rises upward through all the parts, and the air can thus easily escape through other channels cut for that purpose. It should be here mentioned for the benefit of those unacquainted with the nature of metal casting that there must always be provided an inner mould, or as it is termed a core, to regulate the thickness of the metal. This is managed by laying on the surface of the outer mould clay of the required thickness, and then filling up the interior with the same material as the mould itself, after which the outer mould is removed and the clay taken away, leaving the necessary vacancy for the metal between the two when they are again put together. The material to form the mould and core must be of a consistency to retain the impression given to it from the model, of a nature to resist the action of the hot metal and sufficiently porous to allow the escape of gas, without which the liquid fire will not settle quietly and soundly down on its surface. Sand moulds act well as far as the last two are concerned, but are too fragile for the complicated forms of statue moulding, and experience has taught us that a mixture in equal proportions of plaster of Paris and brickdust serves best all purposes, the former giving it consistency and the latter answering all desiderata with regard to the metal. These brickdust and plaster moulds are, of course, tender, and must, therefore, be duly supported with irons embedded within them, as well as built upon iron basements, to enable them to be lifted about without injury by means of cranes. When complete they are bound round by iron hoops, and put into an oven to dry for five or six weeks, according to their size. Care in this particular is highly important, as the least damp will cause a bubbling or disturbance of the metal as it runs in. At the end of this time, when the casting takes place, the mould is lowered into a pit prepared for the purpose, and tightly embedded in sand. Weights are put upon the top to prevent the uprising of any part as the metal enters. Every precaution, in fact, is taken against expansion. Channels are then made of sand from the orifice of the furnace to the mouth of the mould; the furnace is tapped, and the liquid flame rushes out through the roads so formed for it. This is the anxious moment upon which the result of many weeks' work depends. If the metal run quietly down the mould, and appear again up the passages formed for the escape of the air, it is but reasonable to infer that it has traveled through every part, and that a good cast will be the result. But if by chance a beautiful jet-de-feu takes place, reaching almost to the foundry roof, it may be as well to retire to a respectful distance, notwithstanding that the dispersion of so much valuable metal may create a desire to see where it falls. The moulder, too, may recommence his work immediately, for waiting until to-morrow, when the mould and cast are to be dug out of the pit, will be scarcely worth while.

No bronze mould can serve for more than once, and the cast will be found to have a strong resemblance to a honeycomb, very curious, no doubt, but not exactly suited to display clear definition of form. Such noisy and expensive fireworks do not, however, take place in a well managed affair, where there is everything proper for use and every care taken. But the mention of them may serve to caution those who have not the means at hand to do what is right, or who meddle with the process without the necessary knowledge or experience to guide them. Some variety of opinion exists on the question of what this metal called bronze should be composed; but the late Mr. Maudsley, no mean authority, declared 91 of copper to 9 of tin to be the best mixture for figure casting, and his opinion has certainly been found correct. An addition of about one and a half of zinc, put in when the copper is melted, makes it flow more freely. But a greater quantity than this is scarcely justifiable, as zinc is liable to be acted upon by acids, and, if used too freely, may endanger the durability of the statue. The mould comes off from the cast in dry dust, as does also the core from the inside. The parts called runners, formed on the cast by the metal filling up the passages through which it has flowed, and the projecting lines, caused by the seams or joints, have then to be cut off, and any little defects remedied by the chasing tools. The whole should then be scrubbed with emery and water to remove a green scurf attached to it, the presence of which is, however, a sure indication of a good surface beneath. The last proceeding is to join the various parts so cast. This is done by first fastening them together by bolts, and then pouring hot metal from a crucible over the joint,

POLAR BEARS FIGHTING.

6 or 7 inches at a time, when embedded in sand so as to expose nothing but the edges required to be united. When cool this leaves a piece of metal standing up, to be afterward cut away. A repetition of this operation, all along the joint, will be found to unite the parts as solidly as if cast at one time, and will not be at all visible in the finished work. The statue is then complete. Attempts, it is true, are sometimes made to give an artificial color to the metal, by means of acids, before it leaves the foundry; but time does that better than anything else.—The Architect and Contract Reporter.

A FIGHT OF POLAR BEARS.

THE scene brought before us in our illustration shows an intensely critical moment. Two polar bears have attacked each other in a quarrel, probably over some morsel of food, and in their struggle have rolled to the edge of their bath. Here the bear who has secured the upper hand holds the apparently weaker one gripped by the throat and plunges him heavily into the familiar element. The conqueror has his vanquished foe practically at his mercy, nor does the fierce glow of his eyes speak of sparing pity.

Meanwhile the noise of the conflict has called the keepers to the spot, and, dreading the loss of one of their finest specimens, they exert all that is in their power to separate the furious beasts. Poles, spikes, large pieces of timber and heavy stones are the most handy means of distracting the bears' attention from their private enmity. It seems, indeed, that the stone which is just flying in midair at the moment which our cut represents must needs make some impression on the combatant it is aimed at. However, here lies the critical question, the thread on which hangs the fate of the victim. We leave it to our readers to decide whether it shall live or die.

The whole scene carries an impression of giant strength let loose, of huge masses tossed by irresistible powers. This effect is yet heightened by the clumsy bulk of the bears' bodies, their fiercely sparkling eyes and the gaping mouth beset with fearful teeth of the defeated foe.—For our engraving we are indebted to Der Zoologische Garten.

A HAND-SHAPED CARROT.

WE reproduce herewith, from La Nature, a figure of a vegetable curiosity in the form of a hand-shaped carrot which was gathered by a farmer at Boisnithum, near Boulogne-sur-Mer. It will be remarked that the five fingers of the hand are clearly delineated. Some of them doubtless, such as the index and middle finger, have a somewhat irregular form, but there neverthe-

HAND-SHAPED CARROT.

less exist proportions among all of them that make them resemble the fingers of the human hand.

COMMON PLANTS.

EVERY nurseryman's catalogue gives an important place to its list of rare plants, and, of course, the prices of trees and shrubs and herbs which are scarce are higher than those which afford an ample stock to draw upon. This is simply in obedience to the law of supply and demand, which in a general way regulates the prices of every commodity which man desires for use or ornament. In the eye of some persons, however, rare plants are invested with a value which does not belong to them intrinsically. One who has acquired the habit or passion for collecting places the highest value on objects which are unique. A first edition or the only known copy of a book which in itself is nearly worthless may be a prize for which a book collector will give a small fortune; and in the same way an orchid which is the only individual of its species known will command a price quite out of proportion to any charm it may have of form or color or fragrance. The case of one who is studying a given genus of plants is somewhat similar. He may want an iris, for example, to complete his series, and to him the missing plant has an importance that would not belong to it under any other conditions.

All this is readily comprehensible, but there are other people who have a feeling somehow that rarity is in itself an element of beauty in a plant; at all events, if they would not state this broadly, they firmly believe in its converse, namely, that a plant which is common is not desirable. It is this idea which lies at the root of the distinction between "common trees" and "ornamental trees" which we so often hear. This notion was once so prevalent that it was a difficult thing a few years ago to find common American forest trees and shrubs for sale in American nurseries. When Central Park was planted it was easy enough to buy European birches, Norway maples and horse-chestnuts, but few nurseries had our own canoe birch or pin oak or pepperidge. English hawthorns could be had by the hundred, but many of our native thorns were not propagated at all. Spireas and Kerrias and honeysuckles from abroad could be had by the thousand, but our native honeysuckles and many of the best of the Viburnums and other American shrubs were not classed as ornamental plants at all. Conditions have changed since then somewhat, and the herbaceous plants and shrubs and trees which grow in our own forests and along our waysides have been more freely admitted into the aristocratic society of their foreign relatives, and the fact that a plant is common is not always a reproach to it.

A PLANT OF NEPENTHES × TIVEYI—PITCHERS COLORED BROWN AND GREEN.

Different plants have different values to planters according to the use that is made of them. Landscape gardening wherever it is practiced over areas of considerable extent deals properly with scenery: that is, with the permanent features of the land—its roll of surface, its sky-line and distance. The greatest artist in landscape is one who with these fundamental elements and the common trees and shrubs and grass makes a picture which is a unit, and every portion of which helps consistently to give expression to a central idea. This differs entirely from what is called decorative gardening, which is concerned more especially with the detailed ornamentation of more limited spaces. For decorative purposes plants and flowers may be grouped into arrangements which kindle admiration on account of their symmetry of form and richness of color. This is the presentation of beauty for its own sake. It appeals to the æsthetic sense alone and not to the imagination, and through it to our higher nature as a landscape picture does. It is not necessary that a decorative group should be in any sense natural, and plants with foliage of strong color or those that can be trained into peculiar shapes or which have an unusual habit are often the most valuable in such places. They are useful just as stones of different form and color are useful in a mosaic. In decorative gardening a plant of golden elder or of Prunus pissardii may have the highest value, while the same plants in a natural landscape would be worse than useless, and, indeed, might ruin a quiet picture by their obtrusiveness.

There is another kind of gardening, however, which has been called specimen gardening, and which has many attractions to lovers of plants. To such persons a garden exists for its plants rather than the plants for the garden. It is not a landscape picture that is desired, nor yet geometrical designs of pleasing form and color. It is individual plants that are cherished irrespective of their arrangement, and they may be selected for their rarity or their oddity, or for any other quality that appeals to the fancy of the planter. This makes a pleasant diversion, but it is by no means the highest form of gardening. A wise observer once said that it marked a distinct decline in garden art when a gentleman led you to a point on his estate where he could show you the finest Cryptomeria in England, instead of conducting you to the point where you might see the most delightful view.

But we have wandered from our purpose. We set out to make a mild protest against the idea that a plant is not desirable if it is common. A great patron of horticulture once declared that he could get up no enthusiasm for lilacs because they could be seen at every farm-house door. Now, since there are hundreds of varieties of the common lilac and many distinct species besides, there is opportunity for gathering a collection of these shrubs, which represent a wide diversity of habit as well as in the form and color of their flowers—many of them rare plants which never graced a farmer's yard. But the common lilac itself will always be a desirable shrub. It has such intrinsic merit that it cannot be vulgarized by mere abundance. Its habit of growth, the graceful way in which its dense panicles of flowers are carried above the thick leaves, their exquisite color, which has no exact duplicate in the vegetable kingdom; the fragrance, which is their own and unmistakable, will always make this a useful plant. It is hardy, long-lived, and will endure abuse; it is often found by a wayside cabin without a single companion, and yet it is beautiful enough to have been the chief ornament of the home of one of our great poets. It is admired because of its many good qualities, and it will be more and more valued for association by every succeeding generation of plant lovers. The fact is, that for all practical purposes the cheapest plants are the best. Among the novel introductions every year there are some that will stand the test of time, and as soon as they demonstrate their usefulness they will be common. In order to be widely useful a plant must be easily propagated, it must be hardy and long-lived, and these are qualities that will ultimately make it cheap, just as the Tartarian honeysuckle is cheap, although one of the most beautiful and indispensable of shrubs. Grass is common, but it is an unfailing refreshment to the eye, and it is so universally appreciated that no one considers Ruskin's glowing description pitched on too high a key. No novice need be deterred from planting trees or shrubs on account of the high price of novelties or rarities. If his purse will allow him to import the most expensive sorts, he may find pleasure in gratifying his desires in this direction, but if he buys no others he will discover at last that he has but a sickly lot of incongruities. He will learn that the common plants are the basis of every good collection, and that cheap plants are the most effective in producing pictures which are impressive and permanent.—Garden and Forest.

NEPENTHES × TIVEYI.

OUR illustrations represent a full-sized pitcher and the plant as it appears at the present time, of a new hybrid of Nepenthes raised at the Royal Exotic Nursery, Chelsea, and exhibited at the Royal Horticultural Society's meeting held at Westminster. The plant is

PITCHER OF NEPENTHES × TIVEYI.

the result of a cross between the species N. Curtisii and N. Veitchi. The ground color of the body of the pitcher is of a light green, streaked and blotched with a bright brown tint, as is likewise the prolongation of the midrib of the leaf on which the pitcher depends. A conspicuous feature is the broad, convex rim of the pitcher, which is of bright reddish brown, running into

a lighter shade toward the inner edge, and beautifully lined. The operculum or lid resembles the rest of the pitcher in regard to the ground color and markings; the wings are green, and possess a few long hairs. The pitchers in general partake of the characteristics of both parents—N. Veitchi, a Bornean species of great beauty, going sometimes under the names of villosa and sanguinea. We are indebted to the Gardeners' Chronicle for the cuts and particulars.

AN UNDISCOVERED GAS.*

By Prof. WILLIAM RAMSAY, Ph.D., LL.D., Sc.D., F.R.S.

THE subject of my remarks to-day is a new gas. I shall describe to you later its curious properties; but it would be unfair not to put you at once in possession of the knowledge of its most remarkable property—it has not yet been discovered. As it is still unborn, it has not yet been named. The naming of a new element is no easy matter. For there are only twenty-six letters in our alphabet, and there are already over seventy elements. To select a name expressible by a symbol which has not already been claimed for one of the known elements is difficult, and the difficulty is enhanced when it is at the same time required to select a name which shall be descriptive of the properties (or want of properties) of the element. It is now my task to bring before you the evidence for the existence of this undiscovered element.

It was noticed by Döbereiner, as long ago as 1817, that certain elements could be arranged in groups of three. The choice of the elements selected to form these triads was made on account of their analogous properties, and on the sequence of their atomic weights, which had at that time only recently been discovered. Thus calcium, strontium and barium formed such a group; their oxides, lime, strontia, and baryta, are all easily slaked, combining with water to form soluble lime water, strontia water and baryta water. Their sulphates are all sparingly soluble, and resemblance had been noticed between their respective chlorides and between their nitrates. Regularity was also displayed by their atomic weights. The numbers then accepted were 20, 42·5 and 65; and the atomic weight of strontium, 42·5, is the arithmetical mean of those of the other two elements, for (65 + 20)/2 = 42·5. The existence of other similar groups of three was pointed out by Döbereiner, and such groups became known as "Döbereiner's triads."

Another method of classifying the elements, also depending on their atomic weights, was suggested by Pettenkofer, and afterward elaborated by Kremers, Gladstone and Cooke. It consisted in seeking for some expression which would represent the differences between the atomic weights of certain allied elements. Thus the difference between the atomic weight of lithium, 7, and sodium, 23, is 16; and between that of sodium and of potassium, 39, is also 16. The regularity is not always so conspicuous. Dumas, in 1857, contrived a somewhat complicated expression which, to some extent, exhibited regularity in the atomic weights of fluorine, chlorine, bromine and iodine; and also of nitrogen, phosphorus, arsenic, antimony and bismuth.

The upshot of these efforts to discover regularity was that, in 1864, Mr. John Newlands, having arranged the elements in eight groups, found that when placed in the order of their atomic weights, "the eighth element, starting from a given one, is a kind of repetition of the first, like the eighth note of an octave in music." To this regularity he gave the name "The law of octaves."

The development of this idea, as all chemists know, was due to the late Prof. Lothar Meyer, of Tübingen, and to Prof. Mendeleeff, of St. Petersburg. It is generally known as the "Periodic Law." One of the simplest methods of showing this arrangement is by means of a cylinder divided into eight segments by lines drawn parallel to its axis; a spiral line is then traced round the cylinder, which will, of course, be cut by these lines eight times at each revolution. Holding the cylinder vertically, the name and atomic weight of an element is written at each intersection of the spiral with a vertical line, following the numerical order of the atomic weights. It will be found, according to Lothar Meyer and Mendeleeff, that the elements grouped down each of the vertical lines form a natural class; they possess similar properties, form similar compounds, and exhibit a graded relationship between their densities, melting points and many of their other properties. One of these vertical columns, however, differs from the others, inasmuch as on it there are three groups, each consisting of three elements with approximately equal atomic weights. The elements in question are iron, cobalt and nickel; palladium, rhodium and ruthenium; and platinum, iridium and osmium. There is apparently room for a fourth group of three elements in this column, and it may be a fifth. And the discovery of such a group is not unlikely, for when this table was first drawn up Prof. Mendeleeff drew attention to certain gaps, which have since been filled up by the discovery of gallium, germanium and others.

The discovery of argon at once raised the curiosity of Lord Rayleigh and myself as to its position in this table. With a density of nearly twenty, if a diatomic gas, like oxygen and nitrogen, it would follow fluorine in the periodic table; and our first idea was that argon was probably a mixture of three gases, all of which possessed nearly the same atomic weights, like iron, cobalt and nickel. Indeed, their names were suggested, on this supposition, with patriotic bias, as Anglium, Scotium and Hibernium! But when the ratio of its specific heats had, at least in our opinion, unmistakably shown that it was molecularly monatomic, and not diatomic, as at first conjectured, it was necessary to believe that its atomic weight was 40, and not 20, and that it followed chlorine in the atomic table, and not fluorine. But here arises a difficulty. The atomic weight of chlorine is 35·5 and that of potassium, the next element in order in the table, is 39·1; and that of argon, 40, follows, and does not precede, that of potassium, as it might be expected to do. It still remains possible that argon, instead of consisting wholly of monatomic molecules, may contain a small percentage of diatomic molecules; but the evidence in favor of this supposition is, in my opinion, far from strong. Another possibility is that argon, as at first conjectured, may consist of a mixture of more than one element; but, unless the atomic weight of one of the elements in the supposed mixture is very high, say 82, the case is not bettered, for one of the elements in the supposed trio would still have a higher atomic weight than potassium. And very careful experiments, carried out by Dr. Norman Collie and myself, on the fractional diffusion of argon, have disproved the existence of any such element with high atomic weight in argon, and indeed have practically demonstrated that argon is a simple substance, and not a mixture.

The discovery of helium has thrown a new light on this subject. Helium, it will be remembered, is evolved on heating certain minerals, notably those containing uranium; although it appears to be contained in others in which uranium is not present, except in traces. Among these minerals are cleveite, monazite, fergusonite, and a host of similar complex mixtures, all containing rare elements, such as niobium, tantalum, yttrium, cerium, etc. The spectrum of helium is characterized by a remarkably brilliant yellow line, which had been observed as long ago as 1868 by Profs. Frankland and Lockyer in the spectrum of the sun's chromosphere, and named "helium" at that early date.

The density of helium proved to be very close to 2·0, and like argon, the ratio of its specific heat showed that it, too, was a monatomic gas. Its atomic weight therefore is identical with its molecular weight, viz., 4·0, and its place in the periodic table is between hydrogen and lithium, the atomic weight of which is 7·0.

The difference between the atomic weights of helium and argon is thus 36, or 40—4. Now there are several cases of such a difference. For instance, in the group the first member of which is fluorine we have—

Fluorine	19	
Chlorine	35·5	16·5 19·5
Manganese	55	

In the oxygen group—

Oxygen	16	
Sulphur	32	16 20·3
Chromium	52·3	

In the nitrogen group—

Nitrogen	14	
Phosphorus	31	17 20·4
Vanadium	51·4	

And in the carbon group—

Carbon	12	
Silicon	28·3	16·3 19·8
Titanium	48·1	

These instances suffice to show that approximately the differences are 16 and 20 between consecutive members of the corresponding groups of elements. The total differences between the extreme members of the short series mentioned are—

Manganese—fluorine	36
Chromium—oxygen	36·3
Vanadium—nitrogen	37·4
Titanium—carbon	36·1

This is approximately the difference between the atomic weights of helium and argon, 36.

There should, therefore, be an undiscovered element between helium and argon, with an atomic weight 16 units higher than that of helium, and 20 units lower than that of argon, namely, 20. And if this unknown element, like helium and argon, should prove to consist of monatomic molecules, then its density should be half its atomic weight, 10. And pushing the analogy still farther, it is to be expected that this element should be as indifferent to union with other elements as the two allied elements.

My assistant, Mr. Morris Travers, has indefatigably aided me in a search for this unknown gas. There is a proverb about looking for a needle in a haystack; modern science, with the aid of suitable magnetic appliances, would, if the reward were sufficient, make short work of that proverbial needle. But here is a supposed unknown gas, endowed no doubt with negative properties, and the whole world to find it in. Still, the attempt had to be made.

We first directed our attention to the sources of helium—minerals. Almost every mineral which we could obtain was heated in a vacuum, and the gas which was evolved examined. The results are interesting. Most minerals give off gas when heated, and the gas contains, as a rule, a considerable amount of hydrogen, mixed with carbonic acid, questionable traces of nitrogen, and carbonic oxide. Many of the minerals, in addition, gave helium, which proved to be widely distributed, though only in minute proportion. One mineral—malacone—gave appreciable quantities of argon; and it is noteworthy that argon was not found except in it (and, curiously, in much larger amount than helium) and in a specimen of meteoric iron. Other specimens of meteoric iron were examined, but were found to contain mainly hydrogen, with no trace of either argon or helium. It is probable that the sources of meteorites might be traced in this manner, and that each could be relegated to its particular swarm.

Among the minerals examined was one to which our attention had been directed by Prof. Lockyer, named eliasite, from which he said that he had extracted a gas in which he had observed spectrum lines foreign to helium. He was kind enough to furnish us with a specimen of this mineral, which is exceedingly rare, but the sample which we tested contained nothing but undoubted helium.

During a trip to Iceland in 1895 I collected some gas from the boiling springs there. It consisted, for the most part, of air, but contained somewhat more argon than is usually dissolved when air is shaken with water.

In the spring of 1896 Mr. Travers and I made a trip to the Pyrenees to collect gas from the mineral springs of Cauterets, to which our attention had been directed by Dr. Bouchard, who pointed out that these gases are rich in helium. We examined a number of samples from the various springs, and confirmed Dr. Bouchard's results, but there was no sign of any unknown lines in the spectrum of these gases. Our quest was in vain.

We must now turn to another aspect of the subject. Shortly after the discovery of helium, its spectrum was very carefully examined by Profs. Runge and Paschen, the renowned spectroscopists. The spectrum was photographed, special attention being paid to the invisible portions, termed the "ultra-violet" and "infra-red." The lines thus registered were found to have a harmonic relation to each other. They admitted of division into two sets, each complete in itself. Now, a similar process had been applied to the spectrum of lithium and to that of sodium, and the spectra of these elements gave only one series each. Hence, Profs. Runge and Paschen concluded that the gas, to which the provisional name of helium had been given, was, in reality, a mixture of two gases, closely resembling each other in properties. As we know no other elements with atomic weights between those of hydrogen and lithium, there is no chemical evidence either for or against this supposition. Prof. Runge supposed that he had obtained evidence of the separation of these imagined elements from each other by means of diffusion; but Mr. Travers and I pointed out that the same alteration of spectrum, which was apparently produced by diffusion, could also be caused by altering the pressure of the gas in the vacuum tube; and shortly after Prof. Runge acknowledged his mistake.

These considerations, however, made it desirable to subject helium to systematic diffusion, in the same way as argon had been tried. The experiments were carried out in the summer of 1896 by Dr. Collie and myself. The result was encouraging. It was found possible to separate helium into two portions of different rates of diffusion, and consequently of different density, by this means. The limits of separation, however, were not very great. On the one hand, we obtained gas of a density close on 2·0; and on the other, a sample of density 2·4 or thereabout. The difficulty was increased by the curious behavior, which we have often had occasion to confirm, that helium possesses a rate of diffusion too rapid for its density. Thus, the density of the lightest portion of the diffused gas, calculated from its rate of diffusion, was 1·874; but this corresponds to a real density of about 2·0. After our paper, giving an account of these experiments, had been published, a German investigator, Herr A. Hagenbach, repeated our work and confirmed our results.

The two samples of gas of different density differ also in other properties. Different transparent substances differ in the rate at which they allow light to pass through them. Thus, light travels through water at a much slower rate than through air, and at a slower rate through air than through hydrogen. Now Lord Rayleigh found that helium offers less opposition to the passage of light than any other substance does, and the heavier of the two portions into which helium had been split offered more opposition than the lighter portion. And the retardation of the light, unlike what has usually been observed, was nearly proportional to the densities of the samples. The spectrum of these two samples did not differ in the minutest particular; therefore it did not appear quite out of the question to hazard the speculation that the process of diffusion was instrumental, not necessarily in separating two kinds of gas from each other, but actually in removing light molecules of the same kind from heavy molecules. This idea is not new. It had been advanced by Prof. Schützenberger (whose recent death all chemists have to deplore), and later by Mr. Crookes, that what we term the atomic weight of an element is a mean; that when we say that the atomic weight of oxygen is 16, we merely state that the average atomic weight is 16; and it is not inconceivable that a certain number of molecules have a weight somewhat higher than 32, while a certain number have a lower weight.

We therefore thought it necessary to test this question by direct experiment with some known gas; and we chose nitrogen, as a good material with which to test the point. A much larger and more convenient apparatus for diffusing gases was built by Mr. Travers and myself, and a set of systematic diffusions of nitrogen was carried out. After thirty rounds, corresponding to 180 diffusions, the density of the nitrogen was unaltered, and that of the portion which should have diffused most slowly, had there been any difference in rate, was identical with that of the most quickly diffusing portion, i. e., with that of the portion which passed first through the porous plug. This attempt, therefore, was unsuccessful; but it was worth carrying out, for it is now certain that it is not possible to separate a gas of undoubted chemical unity into portions of different density by diffusion. And these experiments rendered it exceedingly improbable that the difference in density of the two fractions of helium was due to separation of light molecules of helium from heavy molecules.

The apparatus used for diffusion had a capacity of about two liters. It was filled with helium, and the operation of diffusion was carried through thirty times. There were six reservoirs, each full of gas, and each was separated into two by diffusion. To the heavier portion of one lot, the lighter portion of the next was added, and in this manner all six reservoirs were successively passed through the diffusion apparatus. This process was carried out thirty times, each of the six reservoirs having had its gas diffused each time, thus involving 180 diffusions. After this process, the density of the more quickly diffusing gas was reduced to 2·02, while that of the less quickly diffusing had increased to 2·27. The light portion on rediffusion hardly altered in density, while the heavier portion, when divided into three portions by diffusion, showed a considerable difference in density between the first third and the last third.

A similar set of operations was carried out with a fresh quantity of helium, in order to accumulate enough gas to obtain a sufficient quantity for a second series of diffusions. The more quickly diffusing portions of both gases were mixed and rediffused. The density of the lightest portion of these gases was 1·98; and after other fifteen diffusions, the density of the lightest portion had not decreased. The end had been reached; it was not possible to obtain a lighter portion by diffusion. The density of the main body of this gas is therefore 1·98; and its refractivity, air being taken as unity, is 0·1245. The spectrum of this portion does not differ in any respect from the usual spectrum of helium.

As rediffusion does not alter the density or the refractivity of this gas, it is right to suppose that either one definite element has now been isolated; or that if there

* Address before the chemical section of the British Association for the Advancement of Science.

are more elements than one present, they possess the same, or very nearly the same, density and refractivity. There may be a group of elements, say three, like iron, cobalt, and nickel; but there is no proof that this idea is correct, and the simplicity of the spectrum would be an argument against such a supposition. This substance, forming by far the larger part of the whole amount of the gas, must in the present state of our knowledge be regarded as pure helium.

On the other hand, the heavier residue is easily altered in density by rediffusion, and this would imply that it consists of a small quantity of a heavy gas mixed with a large quantity of the light gas. Repeated rediffusion convinced us that there was only a very small amount of the heavy gas present in the mixture. The portion which contained the largest amount of heavy gas was found to have the density 2·275, and its refractive index was found to be 0·1333. On rediffusing this portion of gas until only a trace sufficient to fill a Plücker's tube was left, and then examining the spectrum, no unknown lines could be detected, but, on interposing a jar and spark gap, the well known blue lines of argon became visible; and even without the jar the red lines of argon and the two green groups were distinctly visible. The amount of argon present, calculated from the density, was 1·64 per cent., and from the refractivity 1·14 per cent. The conclusion had therefore to be drawn that the heavy constituent of helium, as it comes off the minerals containing it, is nothing new, but, so far as can be made out, merely a small amount of argon.

If, then, there is a new gas in what is generally termed helium, it is mixed with argon, and it must be present in extremely minute traces. As neither helium nor argon has been induced to form compounds, there does not appear to be any method, other than diffusion, for isolating such a gas, if it exists, and that method has failed in our hands to give any evidence of the existence of such a gas. It by no means follows that the gas does not exist; the only conclusion to be drawn is that we have not yet stumbled on the material which contains it. In fact, the haystack is too large and the needle too inconspicuous. Reference to the periodic table will show that between the elements aluminum and indium there occurs gallium, a substance occurring only in the minutest amount on the earth's surface; and following silicon, and preceding tin, appears the element germanium, a body which has as yet been recognized only in one of the rarest of minerals, argyrodite. Now, the amount of helium in fergusonite, one of the minerals which yields it in reasonable quantity, is only 33 parts by weight in 100,000 of the mineral; and it is not improbable that some other mineral may contain the new gas in even more minute proportion. If, however, it is accompanied in its still undiscovered source by argon and helium, it will be a work of extreme difficulty to effect a separation from these gases.

In these remarks it has been assumed that the new gas will resemble argon and helium in being indifferent to the action of reagents, and in not forming compounds. This supposition is worth examining. In considering it, the analogy with other elements is all that we have to guide us.

We have already paid some attention to several triads of elements. We have seen that the differences in atomic weights between the elements fluorine and manganese, oxygen and chromium, nitrogen and vanadium, carbon and titanium, is in each case approximately the same as that between helium and argon, viz., 36. If elements further back in the periodic table be examined, it is to be noticed that the differences grow less, the smaller the atomic weights. Thus, between boron and scandium, the difference is 33; between beryllium (glucinum) and calcium, 31; and between lithium and potassium, 32. At the same time, we may remark that the elements grow liker each other the lower the atomic weights. Now, helium and argon are very like each other in physical properties. It may be fairly concluded, I think, that in so far they justify their position. Moreover, the pair of elements which show the smallest difference between their atomic weights is beryllium and calcium; there is a somewhat greater difference between lithium and potassium. And it is in accordance with this fragment of regularity that helium and argon show a greater difference. Then again sodium, the middle element of the lithium triad, is very similar in properties both to lithium and potassium; and we might, therefore, expect that the unknown element of the helium series should closely resemble both helium and argon.

Leaving now the consideration of the new element, let us turn our attention to the more general question of the atomic weight of argon, and its anomalous position in the periodic scheme of the elements. The apparent difficulty is this: The atomic weight of argon is 40; it has no power to form compounds, and thus possesses no valency; it must follow chlorine in the periodic table, and precede potassium; but its atomic weight is greater than that of potassium, whereas it is generally contended that the elements should follow each other in the order of their atomic weights. If this contention is correct, argon should have an atomic weight smaller than 40.

Let us examine this contention. Taking the first row of elements, we have:

$$Li = 7,\ Be = 9{\cdot}8,\ B = 11,\ C = 12,\ N = 14,\ O = 16,\ F = 19,\ ? = 20.$$

The differences are:

2·8, 1·2, 1·0, 2·0, 2·0, 3·0, 1·0.

It is obvious that they are irregular. The next row shows similar irregularities. Thus:

$$(? = 20),\ Na = 23,\ Mg = 24{\cdot}3,\ Al = 27,\ Si = 28,\ P = 31,\ S = 32,\ Cl = 35{\cdot}5,\ A = 40.$$

And the differences:

3·0, 1·3, 2·7, 1·0, 3·0, 1·0, 3·5, 4·5.

The same irregularity might be illustrated by a consideration of each succeeding row. Between argon and the next in order, potassium, there is a difference of —0·9; that is to say, argon has a higher atomic weight than potassium by 0·9 unit; whereas it might be expected to have a lower one, seeing that potassium follows argon in the table. Farther on in the table there is a similar discrepancy. The row is as follows:

$$Ag = 108,\ Cd = 112,\ In = 114,\ Sn = 119,\ Sb = 120{\cdot}3,\ Te = 127{\cdot}7,\ I = 127.$$

The differences are:

4·0, 2·0, 5·0, 1·3, 7·2, —0·7.

Here again there is a negative difference between tellurium and iodine. And this apparent discrepancy has led to many and careful redeterminations of the atomic weight of tellurium. Prof. Brauner, indeed, has submitted tellurium to methodical fractionation, with no positive results. All the recent determinations of its atomic weight give practically the same number, 127·7.

Again, there have been almost innumerable attempts to reduce the differences between the atomic weights to regularity, by contriving some formula which will express the numbers which represent the atomic weights, with all their irregularities. Needless to say, such attempts have in no case been successful. Apparent success is always attained at the expense of accuracy, and the numbers reproduced are not those accepted as the true atomic weights. Such attempts, in my opinion, are futile. Still, the human mind does not rest contented in merely chronicling such an irregularity; it strives to understand why such an irregularity should exist. And, in connection with this, there are two matters which call for our consideration. These are: Does some circumstance modify these "combining proportions" which we term "atomic weights"? And is there any reason to suppose that we can modify them at our will? Are they true "constants of Nature," unchangeable, and once for all determined? Or are they constant merely so long as other circumstances, a change in which would modify them, remain unchanged?

In order to understand the real scope of such questions, it is necessary to consider the relation of the "atomic weights" to other magnitudes, and especially to the important quantity termed "energy."

It is known that energy manifests itself under different forms, and that one form of energy is quantitatively convertible into another form, without loss. It is also known that each form of energy is expressible as the product of two factors, one of which has been termed the "intensity factor," and the other the "capacity factor." Prof. Ostwald, in the last edition of his "Allgemeine Chemie," classifies some of these forms of energy as follows:

Kinetic energy is the product of mass into the square of velocity.

Linear energy is the product of length into force.

Surface energy is the product of surface into surface tension.

Volume energy is the product of volume into pressure.

Heat energy is the product of heat capacity (entropy) into temperature.

Electrical energy is the product of electric capacity into potential.

Chemical energy is the product of "atomic weight" into affinity.

In each statement of factors, the "capacity factor" is placed first and the "intensity factor" second.

In considering the "capacity factors," it is noticeable that they may be divided into two classes. The two first kinds of energy, kinetic and linear, are independent of the nature of the material which is subject to the energy. A mass of lead offers as much resistance to a given force, or, in other words, possesses as great inertia, as an equal mass of hydrogen. A mass of iridium, the densest solid, counterbalances an equal mass of lithium, the lightest known solid. On the other hand, surface energy deals with molecules, and not with masses. So does volume energy. The volume energy of two grammes of hydrogen, contained in a vessel of one liter capacity, is equal to that of thirty-two grammes of oxygen at the same temperature, and contained in a vessel of equal size. Equal masses of tin and lead have not equal capacity for heat; but 119 grammes of tin has the same capacity as 207 grammes of lead, that is, equal atomic masses have the same heat capacity. The quantity of electricity conveyed through an electrolyte under equal difference of potential is proportional, not to the mass of the dissolved body, but to its equivalent, that is, to some simple fraction of its atomic weight. And the capacity factor of chemical energy is the atomic weight of the substance subjected to the energy. We see, therefore, that while mass or inertia are important adjuncts of kinetic and linear energies, all other kinds of energy are connected with atomic weights, either directly or indirectly.

Such considerations draw attention to the fact that quantity of matter (assuming that there exists such a carrier of properties as we term "matter") need not necessarily be measured by its inertia, or by gravitational attraction. In fact, the word "mass" has two totally distinct significations. Because we adopt the convention to measure quantity of matter by its mass, the word "mass" has come to denote "quantity of matter." But it is open to anyone to measure a quantity of matter by any other of its energy factors. I may, if I choose, state that those quantities of matter which possess equal capacities for heat are equal; or that "equal numbers of atoms" represent equal quantities of matter. Indeed, we regard the value of material as due rather to what it can do, than to its mass; and we buy food, in the main, on an atomic, or perhaps, a molecular basis, according to its content of albumen. And most articles depend for their value on the amount of food required by the producer or the manufacturer.

The various forms of energy may therefore be classified as those which can be referred to an "atomic" factor and those which possess a "mass" factor. The former are in the majority. And the periodic law is the bridge between them, as yet, an imperfect connection. For the atomic factors, arranged in the order of their masses, display only a partial regularity. It is undoubtedly one of the main problems of physics and chemistry to solve this mystery. What the solution will be is beyond my power of prophecy; whether it is to be found in the influence of some circumstance on the atomic weig[illegible] hitherto regarded as among the most [illegible]ants of nature;" or whether it will tur[illegible] mass and gravitational attraction are influenced [illegible]perature, or by electrical charge, I cannot [illegible] but some means will ultimately be found [illegible] these apparent discrepancies, I firmly believe [illegible] conciliation is necessary, whatever view [illegible] nature of the universe and of its mode [illegible] whatever units we may choose to regard as [illegible] among those which lie at our disposal.

In this address I have endeavored to fulfill my promise to combine a little history, a little actuality and a little prophecy. The history belongs to the Old World. I have endeavored to share passing events with the New; and I will ask you to join with me in the hope that much of the prophecy may meet with its fulfillment on this side of the ocean.

ARE GENIUSES LONG LIVED?

No, says the popular verdict, based not unreasonably on the idea that the drain on the nervous forces which is attendant upon genius is not conducive to longevity. Yes, says a writer, David Lindsay, in the Gentleman's Magazine, basing his answer upon a long array of figures showing the age at death of a large number of the world's most illustrious sons, selected "with strict impartiality," which figures prove that nearly one-half of the greatest geniuses of the world have passed the Psalmist's limit of threescore years and ten. We give below his tables, which, it will be observed, include none of the gentler sex:

MILITARY MEN.

Name	Age at death	Name	Age at death
Xenophon	90	Charlemagne	72
Dumouriez	84	Timur	68
Wellington	83	Themistocles	65
Soult	82	Condé	65
Bernadotte	80	Dionysius the Elder	63
Musa Ibn Noseyr	77	Hannibal	63
Blücher	76	Turenne	62
Frederick the Great	74	Sulla	60
Agathocles	72	Massena	58
Genghis Khan	72	Pyrrhus	52
Tilly	71	Napoleon	51
Marlborough	70	Alexander the Great	32
Marius	70		

STATESMEN.

Name	Age at death	Name	Age at death
Benjamin Franklin	84	Cicero	63
Talleyrand	84	William the Conqueror	60
Paoli	82	Louis the Eleventh	60
Palmerston	80	Cromwell	59
Lord Burleigh	77	Machiavelli	58
Augustus Cæsar	76	Richelieu	57
Cosmo dei Medici	75	Fox	57
Disraeli	75	Julius Cæsar	56
Chatham	69	Alfred the Great	52
Edward the First	68	Pitt	47
Walpole	68	Mirabeau	42
Washington	67		

SCIENTISTS AND PHILOSOPHERS.

Name	Age at death	Name	Age at death
Humboldt	89	Linnæus	70
Carlyle	85	Leibnitz	70
Newton	84	Huxley	70
Herschel	84	Socrates	68
Plato	82	Arago	67
Buffon	80	Aristotle	62
Kant	79	Cuvier	62
Galileo	78	Hegel	61
Locke	72	Tycho Brahé	55
Epicurus	72	Descartes	53
Copernicus	70	Spinoza	44

LITERARY MEN.

Name	Age at death	Name	Age at death
Sophocles	90	Cervantes	68
Izaak Walton	90	Dryden	68
Voltaire	84	Milton	65
Goethe	83	Sir Walter Scott	61
Victor Hugo	83	Bunyan	60
Hallam	81	Racine	59
Livy	80	Macaulay	59
Corneille	78	Horace	57
Herodotus	76	Dickens	57
Samuel Johnson	75	Dante	56
Euripides	74	Pope	56
Froissart	73	Gibbon	56
Chaucer	72	Shakespeare	52
Thucydides	70	Virgil	51
Petrarch	70	Molière	51
Defoe	70	Schiller	45
Rabelais	70	Burns	37
Wordsworth	77	Byron	36
Æschylus	69	Shelley	30

MUSICIANS.

Name	Age at death	Name	Age at death
Haydn	77	Schumann	46
Händel	74	Weber	39
Spohr	75	Chopin	39
Palestrina	70	Mendelssohn	38
Bach	65	Mozart	35
Beethoven	56	Schubert	31

PAINTERS.

Name	Age at death	Name	Age at death
Titian	99	Rembrandt	63
Michael Angelo	89	Velasquez	61
Turner	76	Holbein	57
Reynolds	68	Vandyck	42
Hogarth	67	Correggio	40
Rubens	63	Raphael	37

REFORMERS.

Name	Age at death	Name	Age at death
Wesley	87	Knox	67
Swedenborg	84	Mahomet	62
Brigham Young	76	Luther	62
Confucius	71	Calvin	55
Erasmus	69	Savonarola	46

INVENTORS AND DISCOVERERS.

Name	Age at death	Name	Age at death
William Harvey	79	George Stephenson	67
Bessemer	78	Arkwright	60
Jenner	74	Robert Fulton	50

Mr. Lindsay makes the following summary of the tables:

At an age of above 80, 17 per cent. died,
" " 70 to 80, 28 " "
" " 60 to 70, 25 " "
" " 50 to 60, 17 " "
" " under 50, 13 " "

While, therefore, nearly one-half of those whose names appear in the foregoing lists passed the age of seventy, most of their best work, Mr. Lindsay goes on to remark, appeared at a comparatively youthful age. He continues:

"What, then, are the laws that control the age of genius? Why should a Keats die at twenty-four and a Chaucer at seventy-two? Why should philosophers and men who look deeply into the heart of things, and who would naturally be supposed to wear out their vital energy more quickly than other men—why should these be longer lived than musicians?

"To this latter question there is an answer. It is not until after long years of technical training and brain working that such men as Leibnitz and Descartes

blossom out into all their glory of genius; and there are doubtless many great thinkers even now in our midst who may some day astonish the world by the brilliancy of their teachings—but they may first die. With music it is different. Beethoven, while yet in his early infancy, showed unmistakable signs of his natural abilities; when he was a mere youngster he composed works which, to this day, will stand on their own merits. It is the same with every great musician. Granted that he live to reach early manhood, his fame is secured. And at the time when all Europe is ringing with his praises, his science loving brother is toiling in obscurity, not to step forth into the light of popularity for maybe another quarter of a century, or perhaps not at all, for in the meantime, as we have said, he may die.

"It is true that the very greatest masters of all do not usually live out their normal length of days: Napoleon, Cromwell, Shakespeare, Beethoven—none of these passed into old age. But it is hard to define the term 'genius.' If we are to limit it to some score of men, we must then, perhaps, consider that it is incompatible with length of life. If we give the word larger meaning, and honor with it the thousand lesser lights who illumine the page of history, why, then, it would seem to be a healthy thing to be a genius."

Cleaning Beer Pipes.—In cleaning pipes through which beer is run the following precautions should be observed in order that the soda solution used may have its disinfectant effect. The solution should contain 5 to 10 per cent. of soda. It should be in contact with the pipes no less than one-half hour, and the temperature must not be allowed to fall below 80 deg. Centigrade (212 deg. Fah.). The disinfecting action of soda is not very strong. The main value of the process lies in the power soda has of dissolving off the impurities, and so preparing the pipes for further disinfection by steam.—Uhland's Wochenschrift.

THE MANUFACTURE OF TIN PLATES.*

By GEORGE B. HAMMOND, Penarth.

IN accepting the invitation of your council to prepare a paper on the manufacture of tin plates, I am keenly alive to the difficulty of doing justice to a subject which has been so ably dealt with in the interesting papers read before the institute by Mr. Ernest Trubshaw and by the late Mr. P. W. Flower. I venture, however, to undertake the task, as considerable progress has been made in the science and practical mode of manufacture during recent years, and, however unworthy my paper may be in itself, the subject has an important bearing on the steel trade of the country, and claims more than ordinary interest for this district in which you are now meeting, as the neighboring town of Pontypool was the birthplace of the British tin plate trade, about the year 1665, when, under the auspices of the Hanbury family, Mr. Andrew Yarranton made an attempt to establish the manufacture there, on knowledge obtained by him in Saxony, where the trade was at that time in a flourishing condition. Mr. Yarranton's undertaking produced but little results at the time. Other active minds were, however, apparently engaged in the same direction, for it is recorded that one William Chamberlaine took out a patent in the year 1673 for "a newe arte, mistery, or invencon of great use, etc., for plateing and tynning of iron, copper, steele, and brasse, as also for compressing and plateing of all other metalls," which invention related to the use of certain "engines or instruments and wayes and meanes" of tinning and plating iron, etc.; and seventeen years later, in 1691, John Hemingway was granted a patent, owing to influence at the Court of William and Mary, for the sole use for fourteen years of an invention for "makeing of iron plates tynned over, commonly called tynned plates."

This latter patent, though never actively used, was the cause of the industry being abandoned for a time at Pontypool, until, in the year 1720, Major John Hanbury restarted the Pontypool works; but his venture was attended with little success for some years. The method of producing was slow and laborious, the operation being that of flattening out hot slabs of iron under a quick action helve or tilt hammer, the pieces as reduced in thickness being doubled over and piled with other pieces reduced in the same way, the surfaces being sprinkled with powdered coal or charcoal to prevent welding, the hammering being continued until the required size and thickness were obtained. The plates were afterward steeped in a weak solution of sour rye water or vinegar for several days to remove the oxide and other injurious substances formed on the surface of the plates during the operation of forging, and when cleaned, were immersed in a bath of molten tin.

In the year 1728, Major Hanbury and John Payne brought out an invention for rolling sheet iron, and it was found that plates produced by this new method possessed a finer surface, were more uniform in thickness, softer and more pliable in working, and were much esteemed by the consumers of the time.

The trade then spread to some of the neighboring works of Monmouthshire and Glamorganshire, and in some few instances to the other ironmaking districts. The development was gradual, and the production was soon sufficient for the requirements of this country, and the imports from the Continental works ceased. It was not, however, till the present century that the trade made any rapid strides, when, by the advances of science and civilization, the uses to which tin plates may be applied in the canning of fish, fruit, other food stuffs, and oil became known.

The trade, however, gave constantly increasing employment to the laboring classes of South Wales and Monmouthshire, a district which has retained its position as the principal seat of the manufacture for more than 150 years, extending to the present time. Whole families have engaged in the industry in the same localities from generation to generation, until their present representatives, with some reason, look upon the trade as their birthright, and regard with jealous eyes the now rapid growth of the manufacture in other countries, preferring, in times of depression, to follow the trade into distant lands rather than engage in other occupations at home. It is also a noteworthy fact that wherever tin plate works have been established within recent years, Welsh workers have been required to instruct the native labor and to assist in the development of the art. At the present time employment is found in this country for many thousands of workpeople in the industry itself, and many thousands more in those trades which are dependent on providing the materials from which tin plates are produced; one instance of which is the fact that more than half a million tons of British steel bars are annually produced for the purpose, some of our largest steel works being partially, and in some instances wholly, employed in manufacturing this material. The expansion of the trade in this country over the last thirty years has been very marked, and the extent of it may be gathered from the following statistics, taken from the Board of Trade returns, representing the shipments to all countries of the world, and taken at intervals over the period named, but they do not include the plates produced for home consumption, nor—as regards the periods to 1895—the black plate shipped for coating abroad:

Year.	Weight.	Value.	Average Price.
	Tons	£	£
1867	78,906	2,060,410	26·11
1872	118,083	3,896,973	32·94
1877	153,236	3,068,126	19·80
1882	265,039	4,642,125	17·51
1887	353,506	4,792,854	13·56
1891	448,379	7,166,655	15·99
1892	395,449	5,330,216	13·48
1893	379,172	4,991,300	13·16
1894	353,928	4,538,786	12·96
1895	366,120	4,239,198	11·58
	Blackplate 34,868	338,346	
1896	266,963	3,036,015	11·37
	Blackplate 48,405	477,169	

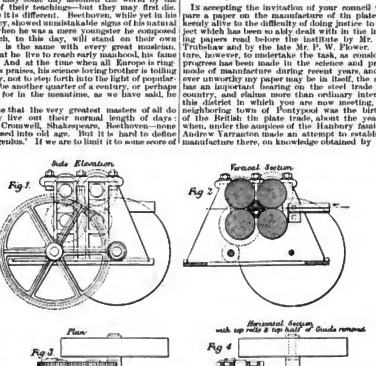
It is interesting to note in the above figures the gradually declining values of the material, and it is doubtless this which has in the past given the stimulus to the trade, and has largely added to the uses for which the material has been adapted. The largest exports were in 1891, and until that year the industry had been almost entirely confined to this country, and the American market was supplied entirely from Wales; but with the introduction of the McKinley tariff, which increased the import duty to 2·2 cents per pound (equivalent to 10s. per cwt.), works were established in the United States, and these have since been operated with considerable success. The growth of the industry there has been very rapid, the estimated output for the years ending June 30, 1892 to 1896, being as follows:

	Tons.
1892	5,903
1893	44,196
1894	62,055
1895	86,160
1896	137,053

In a report lately prepared for the British Foreign Office, it is stated that there are now 180 mills in existence in the United States, 170 of which are working, 11 new ones are in process of construction, with a total potential capacity of 6,250,000 boxes, about equal to the total American consumption in 1896, and the present production is stated to be variously estimated at from 4,000,000 to 5,000,000 boxes a year.

The imports of British tin and terne plates into the United States have rapidly declined in these years, thus:

	Tons.
1891	325,143
1893	290,546
1894	226,990
1895	221,077
1896	113,049



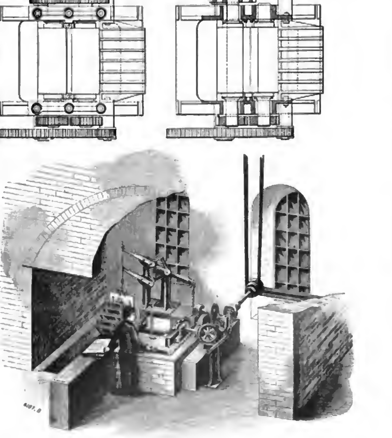


FIG. 8.

THE MANUFACTURE OF TIN PLATES.

* Paper read before the Iron and Steel Institute.

France, Germany, Italy, Spain, and Austria are also producing, and the Welsh makers are anxiously seeking markets abroad. In the meanwhile great depression exists. Of the 490 mills in Great Britain at the present time, only 302 were in operation at the end of April.

During the last fifteen years a great revolution has taken place in the trade by the general adoption of mild steel as a substitute for iron bars, which were formerly produced in the charcoal and puddling forges attached to the tin plate works of the district, with the result that these forges have been entirely abandoned and the tin plate trade proper may now be considered to commence with the rolling of the steel bar into blackplate, although some of the larger works have erected open hearth steel plants. It is my intention, however, to deal with the manufacture commencing with the steel bars.

For this purpose mills are employed, consisting of two pairs of rolls, the first pair for breaking or roughing down the steel bar into plate form, and the second for finishing the plates.

Two heating furnaces and two pairs of shears, to one of which is attached a doubling table and squeezer for doubling and flattening the sheets after elongation between the rolls. The rolls are made of a mixture of strong, tough, cold blast iron, cast in chills. Before being put to work, the necks and bodies are turned in a lathe. After being put in position in the mills the bodies are again dressed and fitted to each other, to work evenly together when expanded at their work.

I may here mention that the general practice in the United States varies by employing one pair of rolls only in a mill, the operation of roughing down and finishing being performed in the same pair, or in some cases three pairs of rolls are employed for two mills, one pair doing the roughing down for the two finishing.

The furnaces are of the reverberatory type, and the bars and sheets charged on the bed of the furnace are acted on by the flame from the grate placed at the back. Defects or wasters are sometimes produced by particles of small coal and ash being carried forward from the grate or picked up from the bed of the furnace, and subsequently rolled into the surface of the sheets. In some modern works, gas producers are employed for supplying the furnaces with fuel, and beneficial results are obtained as regards quality of plates produced and the decrease of wasters.

The workmen employed in the mills are formed in sets, consisting of a roller, doubler, furnaceman, and catcher—the roller being the head, and having charge of the mill. Three sets are employed for eight hours each in a day of twenty-four hours for five days in the week, and one set on the Saturday; the mills run continuously from Monday morning till midday on Saturday. A shearer and three openers generally cut and open the work from each mill.

The operation is as follows: The rough bars from the steel works, of suitable gage, varying from $\frac{1}{4}$ inch to $\frac{3}{8}$ inch thick and 7 inches to 10 inches in width, are cut into short lengths corresponding with the width of the plate to be produced, and are placed in the first or thick iron furnace, and when heated to redness are delivered to the roller, who passes each piece several times between the roughing rolls; the catcher, stationed behind the rolls, catches the pieces as they pass through, and returns them over the top roll. When sufficiently extended, the pieces are replaced in the same furnace, and heat equivalent to that lost in the operation of rolling is restored. When they are again extended by rolling, the doubler doubles the two ends of each piece together, flattening the piece under the squeezer, by which it should be observed the substance for resistance in the next operation of rolling is not diminished. In this stage the pieces are known as "doubles." The doubles are now charged into the second or finishing furnace, leaving the thick iron furnace free to heat another charge of rough bars while the operation of finishing the former is continued. When the "doubles" are heated the pieces are again extended, the second doubling is performed, and the uneven ends are cut off at the shears: "fours" being thus produced. The packs are again subjected to the action of the finishing furnace and prepared for final rolling, or the process is continued after further rolling and doubling to "eights," as may be necessary for the gage required. It is customary in every instance after two or more thicknesses of doubled plates have been rolled together to separate them before reheating, care being taken to replace the pieces in position in the pack; this avoids welding of the surfaces, and facilitates the final separation or opening of the finished sheets. It is known that each piece of rough bar of given weight, if carefully manipulated, will produce so many sheets of the desired size and gage, and considerable skill is required to obtain sufficient length and, at the same time, to avoid exceeding it, or the steel would cut to waste. When the roller is satisfied that he has obtained the above requirements, the pieces are placed on trolleys for conveyance to the finishing shears, and when cool are cut by the shearer into the sizes of the order in hand.

The next process is that of opening or separating the plates pressed together by the final rolling; for this girls are employed, who do the work by hand, separating sheet from sheet with much dexterity. In this state the plates are known as rough blackplate. A machine, for which a big future seems possible, has lately been invented by Messrs. Williams & White, for opening or separating blackplate or sheets, and the following description may be found of interest:

The machine consists essentially of two pairs of rolls, all driven at the same circumferential speed, and placed with their axes all parallel to each other. Between the first and second pair of rolls is placed a "waved guide," consisting of hard, smooth, chilled iron plates. These plates are firmly held at a proper distance from each other, and the "guide" formed by the two plates is firmly held in position between the two pairs of rolls, as shown in Figs. 1, 2, 3 and 4.

The action of the machine is as follows: The packs of unopened blackplate to be opened by the machine are passed through the first pair of rolls. From these they pass through the sinuous passage of the guide plates. After leaving the last bend or curve in the guide, the second pair of rolls seizes the plates and draws the packs through, completing the operation. After leaving the second pair of rolls the packs fall on a trolley, where they accumulate until wheeled away for the next process.

It may be explained that the individual sheets comprising the pack are held together by very thin films of oxide of iron, which forms on the surface during the working of the sheets while hot.

As the packs are forced around the curves of the

Fig. 5.

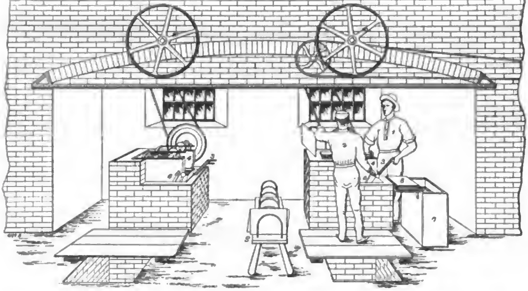


Fig 6 Section AB

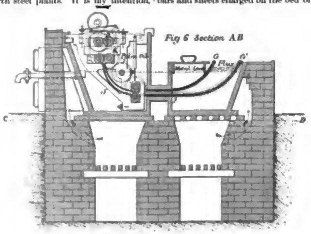
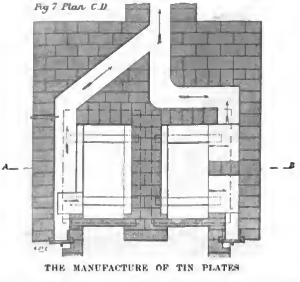


Fig 7 Plan C.D



THE MANUFACTURE OF TIN PLATES

waved passage, the sheets of metal and the films of iron oxide are bent to and fro. This bending to and fro is harmless as far as the metal is concerned, but it is destructive to the films of oxide; hence the cementing medium is destroyed and the sheets are separated. The separation is further assisted by the varying velocities of the individual sheets in passing around the curves of the guides. For example, the sheet next the convex face of the guide travels slower than the sheet next the concave face. This sliding is seen by simply rolling a book with pliable covers, when the leaves step back from each other at the edges and the faces all slide on each other.

This sliding and bending is the principle upon which the machine is constructed, and the principle is the same as that of the method adopted by the girls of bending the corners of the packs when opening by hand.

One machine is capable of opening the work from four or five mills.

The average capacity of an efficient modern tin plate mill is forty to fifty boxes (of 1 cwt. each) in eight hours; but until recently, under their union rules, the workpeople have been restricted to an output of thirty-six boxes; this cannot, however, be upheld, as the only hope for this country to retain a hold on the trade is to obtain big makes and to produce cheaply. The wages paid in the mills known as the "1874 List" are as follows:

Roller, 3s. 5d. per dozen boxes = average of 10s. to 12s. per turn.

Doubler, 2s. 9d. per dozen boxes = average of 8s. to 10s. per turn.

Furnacemen, 2s. 7d. per dozen boxes = average of 7s. 6d. to 9s. 9d. per turn.

Catcher, 1s. 3d. per dozen boxes = average of 3s. 9d. to 4s. 9d. per turn.

Shearing, 1s. 1d. per dozen boxes = average of 10s. to 12s. per turn.

Openers, 6s. 3d. per 100 boxes = average of 2s. 3d. to 2s. 9d. per turn.

Black Pickling.—This operation is necessary to clean the oxide of iron formed by the action of the air on the heated surface of the plates in the mills, and is now universally done by means of machines provided with cradles, in which the plates are packed on their edges in bulk, for immersion first in diluted sulphuric or hydrochloric acid to remove the scaly oxide, and afterward in water to wash off all traces of acid; a quick, vertical, horizontal or rocking motion being conveyed to the cradles to permit the liquid to circulate through and pass between the plates under treatment. The machines most in use are those made by Mr. David Grey, of Maesteg, by the Millbrook Company, of Swansea, and by Messrs. Taylor & Struve, of Briton Ferry, the essential difference in them being the modes by which the cradles are conveyed to and from the acid and water tanks, and by which the motion is applied to the cradles in the liquids.

Great economies have been effected in labor and in the quantities of acid required by these mechanical appliances over the old fashioned hand pickling in leaden vats, the tedious process that was employed twenty years ago.

Black or First Annealing.—The plates after leaving the pickling machines are packed in piles on iron stands and are covered over with inverted iron or steel boxes, called pots, sand being used around the mouth to exclude the air. The boxes with inclosed plates are then subjected to a mild flame in a large reverberatory furnace for eight to ten hours and are then allowed to cool gradually, the object being to soften the plates that they may be more easily polished in the preparation for tinning.

Cold Rolling.—This process consists of passing the plates one by one when cold three or four times between highly polished chilled rolls working under great pressure, and is necessary to remove any buckle or unevenness from the plate and to produce a flat, bright, polished surface for receiving the coating of tin. The plates are hardened by this process, and it is necessary to give them a second or white annealing, the plates being treated in the closed pots as before, but subjected to a milder heat. On cooling they are again soft, with a bright appearance, and are in this state called finished blackplate. A second or white pickling is necessary to remove any oxide formed in the annealing processes. This process is performed in the same way as the first pickling, but the acid solution is weaker, and, after the plates are removed from the swilling tanks, they are kept in water until taken to the tin pot.

Tinning.—In former times this process was performed by soaking the plates in the molten metal and afterward arranging them on edge in a rack fixed in the grease pot to allow the surplus tin to drain off them, the thickness of the coating being determined to some extent by the length of time the plates remained in the hot grease. The process was very wasteful, and it was impossible by its means to obtain a uniform coating over the surface of the plates. About the year 1860 Mr. Edmund Morewood, of Llanelly, and Mr. John Saunders, of Corkley, invented machines with rolls placed in the grease pot to better regulate the quantity of metal, whereby an immense saving was obtained and a superior and more evenly coated plate was produced. This method, with modifications in detail, continues to the present day.

In the process as introduced by Mr. Morewood, the wet plates from the swilling troughs of the white pickling machine were immersed sheet by sheet by the tinman, twenty-five to thirty at a time, in a bath of melted palm oil to absorb the moisture on the surface of the plates and then removed and dipped into a series of pots containing molten tin at various temperatures; and, after being brushed one at a time on both surfaces by the washman with a hempen brush, they were conveyed by him to the grease pot in which the rolls revolved. The plates, on issuing from the rolls in a vertical direction, were raised by a boy and placed in a rack, from which girls removed them to dip in iron for the purpose of removing grease adhering to the surface. They were afterward polished by slightly rubbing with a duster of sheepskin or other soft material, by which the coating operation was completed.

The capacity of modern machines employed in the above method varies from thirty to forty boxes in proportion to the number of rolls working in the grease pot and the class of work in hand. The wages paid under the 1874 list are:

Tinman, 3d. per box = 7s. 6d. to 10s. per day.

Washman, 3d. per box = 7s. 6d. to 10s. per day.

Grease boy, 1d. per box = 2s. 6d. to 3s. 4d. per day.

Dippers, girls (usually two), 7s. per 100 boxes = 2s. to 2s. 9d. each per day.

Dusting, 6d. per 100 boxes = 1s. 9d. to 2s. 4d. per day.

For years past attempts have been made to economize on this method and to employ chloride of zinc as a tinning flux in substitution for palm oil in the first pot, but the results for some time were not satisfactory, and large parcels of plates coated by the experimental processes arrived at their destination in a rusty condition, owing, doubtless, to the presence of free acid in the flux and the porous nature of the iron coated; the workmen also strongly opposed the innovation, and found means to prejudice buyers and consumers against accepting delivery of any plates prepared by such methods as injurious to the food products which would be packed in them; and it was not until steel came into general use, assisted, doubtless, by the more careful preparation of the flux, that any degree of success was attained in this direction.

It is now in general use, and by its means the operation of coating is much more rapidly effected and a brighter finished plate is produced; it has also been proved beyond the possibility of doubt that the material so used is innocuous to the fish, fruit and other goods for the packing of which the plates are employed.

From this change may be dated the successful introduction of mechanical tinning pots, by which farther savings are effected in material and the services of the washman are dispensed with. These mechanical tinning pots, now known in the trade as "patents," are of various makes, the variations consisting principally in detail, each maker claiming some advantage for his machine over that of others. They may, however, be divided into two classes, in one of which the plates travel vertically and in the other in a half circular direction from the flux, through the tin and into the rolls revolving in the grease box end. Of the former type, those of Messrs. Thomas, of Melingriffith, Daniel Edwards, of Morriston, and Thomas & White, of Llangennech, and of the latter, those of Messrs. Taylor, Struve & Company, of Briton Ferry, and Player, of Clydach, are well known machines.

Fig. 5 represents a machine of the vertical type at work. This machine, patented in 1882 by Messrs. Taylor & Leyshon, and made by Messrs. Taylor, Struve & Company, of Briton Ferry, was the first single pot for coating and finishing without the aid of the washman to meet with practical success, and is still in use at many of the most important works to the present time, with very slight alteration in detail. The principle employed being that of drawing or pulling the plates, by means of a nipping appliance working beneath the surface of the metal, through the flux into the tin in a vertical direction, so as to allow the plate to clear itself of any scruff adhering to it. The plates enter and leave the pot perfectly flat, and a coating of any quality may be produced, this being regulated by the speed of the rolls in the grease box and by the quantity of tin in the troughs under the finishing rolls, which also tends to wash off any scruff taken up in the tin pot. The machine is simple in construction and is made of various dimensions to suit the sizes of plates to be dealt with. It is specially adapted also for thin plates or taggers, the thinnest of which can be coated by it.

Figs. 6 and 7 illustrate one of the "half circular" machines. The molten tin occupies the space in the lower part of the pot, the flux lying on the surface of the tin at the feeding end, where it may be confined in position by means of a rectangular box (constructed with four sides and without ends) inserted partly below the surface of the metal. The palm oil also lies on the surface of the tin, but at the delivery end, and is confined by the grease box.

The plate is inserted by the tinman between the iron bars which form the guide, G G', and passes through the flux into the molten metal and is moved onward by a light iron rod in the hand of the tinman until it reaches the revolving rolls, H, by which it is conveyed forward through the guides, J J', out of the tin and into the finishing rolls, K K', revolving in the grease. The plate issuing from the rolls in a coated state is placed by the grease boy in a rack for removal by the dipper.

Two grates are provided, that the temperature at each end of the pot may be separately controlled, a higher degree of heat being necessary at the feeding end than is desirable at the delivery or finishing end; this is further assisted by the narrow passage or neck which forms the connection between and keeps apart the two layer bodies of the metal. Plates of any length can be coated in this pot; the makers inform us they have satisfactorily coated experimentally one continuous length of plate 6 inches in width and 150 feet long.

Some of the half circular machines are constructed with two distinct chambers. By this method the plate, after passing in a half circular direction through the first bath of tin, is conducted by means of rolls over the top of the division into the second bath of metal, above the surface of which the finishing rolls are placed in the grease, the temperature of the separate baths being controlled by a fire for each.

The method of working is substantially the same in nearly all the machines, a tinman and a boy being employed to do all the work.

Fig. 8 illustrates another machine of the vertical type at work. This machine, the invention of Messrs. Rogers & Player, is unique in its operation, as dispensing with the services of the grease boy—a tinman only being employed. The machine is of the vertical type and consists of one tin pot, with a grease pot over it, with one fire for the former and a small one for the latter, by which the necessary temperatures are maintained. The finishing rolls of this grease pot are provided with troughs containing molten metal, in which the rolls revolve with the object of washing or cleaning the plate of any scruff taken up from the tin pots. As the plates issue from the finishing rolls in the ordinary way they are automatically seized and removed to the rack to be dealt with by the dipper. This machine is known in the trade as the "iron man." The amount of tin required for coating by hand or by mechanical appliances is not material. A box of I C 14 × 20 containing 112 sheets, and with a surface area of 435·5 square feet, may be coated with a good common coke finish with about two pounds of tin, a heavier coating being applied for a charcoal finish. By means of the mechanical pots, a saving is effected in the quantity of palm oil used; hemp for brushes is entirely dispensed with and a brighter plate is produced.

Dipping and Cleaning.—The plates, on issuing from the grease pots, are either dipped by hand in fine bran, meal or shudes in two operations (each surface having to be treated), or are mechanically conveyed through the material placed in two troughs in such a way that both sides of the plates may be acted upon. When any grease which remained on the surface has thus been removed, the plates are rubbed by hand, as previously described, or are passed through a nest of rolls covered with soft sheep skins, which revolve at circumferential velocities varying to each other, by which the necessary rubbing is obtained and the dust from the bran trough is removed. The operation being now complete, the plates are sorted, counted, weighed and boxed ready for dispatch from the works.—Engineering

JOHN CABOT AND THE DISCOVERY OF NEWFOUNDLAND.*

The word America has become so completely grafted on to our cosmopolitan speech that we do not, as a rule, stay to consider the rationale of the appellation. It is true that Amerigo Vespucci, a Florentine, was one of the several explorers of the great land now from his name called America. But he was only a follower of another explorer, better known and deservedly honored, Christopher Columbus, after whom a republic, Colombia, has been called. We know that Columbus landed on one of the Bahama Islands—Guanahani or San Salvador, close to the tropic of Cancer—on October 12, 1492. But this was the first voyage of Columbus. He made other voyages, successively discovering new lands. Yet we Englishmen, a nation of great explorers, navigators and seafaring men, appear altogether to have forgotten that it is to the praise of our own King Henry VII that a northern portion of America, over sixteen hundred miles from San Salvador, was discovered, and before that portion was known to Columbus.

John Cabot, a Genoese pilot, but who had been naturalized as a Venetian, came to England and settled at Bristol with his wife and family in the reign of King Henry VII. Cabot, or Cabotta, or Kabotto, as his name is variously spelt, appears in a record in the archives of Venice, under the date March 28, 1476, as having been naturalized there after the usual residence of fifteen years. He had studied cosmography and navigation, and, for those days, had been a great traveler. He had visited Arabia, and seen at Mecca caravans which came from the East bringing vast quantities of spices. He had been told by the merchants who had care of the caravans that the spices brought by them were received by them from other merchants, who in their turn had received them from the remotest countries of the East. He fully believed in the new views which had influenced Columbus as to the roundness of the earth, and was of opinion that by sailing westward he might reach the land whence the spices came.

Details of what occurred are meager; but sufficient evidence is extant to understand some of the main features of the adventure.

Cabot applied for assistance to King Henry VII, who appears to have entered very fully into his plans, as we gather from the letters patent granted by that monarch on March 5 in the eleventh year of his reign (i. e., 1496). They are as follows:

"We have given and conceded, and by these presents do give and concede for us and our heirs to our well-beloved John Cabottus, citizen of Venice, and to Ludovicus, Sebastianus and Sanctus, sons of the said John, and to the heirs and assigns of them and each of them, and their deputies, full and free authority, faculty and power of navigating to all parts, countries and seas of the east, west and north, under our banners, flags and ensigns, with five ships or vessels of what burden or quality soever, and with as many mariners or men as they will have with them in the said ships, upon their own proper costs and charges, to seek out, discover and find whatsoever islands, countries, regions or provinces, of heathens or infidels in whatever part of the world they be which before this time were unknown to all Christians."

The letters patent then proceed to license John and his sons "to fly our banners" on the new lands, and grant the right to John and his sons to possess those lands "as our vassals," they "acquiring for us the dominion, title and jurisdiction of the same." They are to be subject to the obligation "to deduct for our use" a fifth part of the whole capital cargo of every voyage on its arrival at the port of Bristol; they are to return to the port of Bristol only; they are to be free from all customs duties. All mainlands, islands, cities, towns, camps and other places by them discovered "shall not be visited by other our subjects" without the license of John and his sons, their heirs and assigns, or their deputies, on pain of the forfeiting "by such other our subjects" of their vessels and goods. Lastly, these letters direct and command "all other our loving subjects, as well by land as by sea," to be helping and assisting the said John and his sons.

Cabot accordingly set sail in a small ship called the Matthew from the port of Bristol accompanied by two or three other small ships. Hakluyt (Voyages) says that he has copied the following from Fabian's Chronicle, but it is not to be found in any extant copy of that work. The extract is as follows:

"In the 13th year of Henry VII (1497), this year the king, by means of a Venetian, who was very expert and cunning in the knowledge of the circuit of the world and islands of the same, as by a card and other demonstrations he showed himself, caused to man and victual a ship at Bristol to search for an island which he said he knew; divers merchants of London ventured in her small stocks. The Venetian was chief patron, and in the company of the said ship sailed also out of Bristol three or four small ships freighted with merchandise, coarse cloth, caps, laces, and so departed from Bristol in the beginning of May."

It is most unfortunate that no log or account written by Cabot himself has come down to us. Even his map

* Nautical Magazine.

and globe have been lost or perished; we are, therefore, obliged to content ourselves with the testimony of contemporaries. Perhaps the most interesting and fullest account is that written by the Abbé Raimondo de Soncino, envoy of the Duke of Milan at the court of Henry VII, which is so valuable but so little known that we shall transcribe it at length. The Abbé writes* from London under date December 18, 1497, to the Duke, as follows:

"Most Illustrious and Excellent My Lord: Perhaps, among your excellency's many occupations, it may not displease you to learn how his majesty here has won a part of Asia without a stroke of the sword. There is in this kingdom a Venetian fellow—Master John Cabotta by name—of a fine mind, greatly skilled in navigation, who seeing that those most serene kings, first he of Portugal, and then the one of Spain, have occupied unknown islands, determined to make a like acquisition for his majesty aforesaid. And having obtained royal grants that he should have the usufruct of all that he should discover, provided that the ownership of the same be reserved to the crown, with a small ship and eighteen persons he committed himself to fortune; and having set out from Bristol, a western port of this kingdom, and passed the western limits of Hibernia (Ireland), and then standing to the northward he began to steer eastward, leaving (after a few days) the north star on his right hand; and having wandered about considerably, at last he fell in with terra firma, where, having planted the royal banner and taken possession on behalf of this king and taken certain tokens, he returned thence. The said Master John, being foreign born and poor, would not be believed, if his comrades, who are almost all Englishmen and from Bristol, did not testify that what he says is true. This Master John has the description of the world in a chart and also in a solid globe which he has made, and he shows where he landed, and that going toward the east he passed considerably beyond the country of the Tanais.† And they say that it is a very good and temperate country, and they think that Brazil wood and silks grow there, and they affirm that that sea is covered with fishes, which are caught not only with the net, but with baskets, a stone being tied to them in order that the baskets may sink in the water. And this I heard the said Master John relate, and the aforesaid Englishmen, his comrades, say that they will bring so many fishes that this kingdom will no longer have need of Iceland, from which country there comes a very great store of fish which we call stock fish. But Master John has set his mind on something greater, for he expects to go further on toward the east (Levant), from that place already occupied, constantly hugging the shore until he shall be over against an island by him called Cipango,‡ situated in the equinoctial region, where he thinks all the spices of the world and also the precious stones originate; and he says that in former times he was at Mecca, whither spices are brought by caravans from distant countries, and that those who brought them, on being asked where the said spices grow, answered that they do not know, but that other caravans come to their homes with this merchandise from distant countries, and these again say that they are brought to them from other remote regions. And he argues thus: That if the Orientals affirmed to the Southerners that these things come from a distance from them, and so from hand to hand, presupposing the rotundity of the earth, it must be that the last ones get them at the north toward the west; and he said it in such a way that, having nothing to gain or lose by it, I too believe it. And what is more, the king here, who is wise and not lavish, likewise puts some faith in him, for since his return he has made good provision for him, as the same Master John tells me. And it is said that in the spring his majesty aforenamed will fit out some ships and will besides give him all the convicts, and they will go to that country and make a colony, by means of which they hope to establish in London a greater storehouse of spices than there is in Alexandria. And the chief men of the enterprise are of Bristol, great sailors, who, now that they know where to go, say that it is not a voyage of more than fifteen days, nor do they ever have storms after they get away from Hibernia. I have also talked with a Burgundian, a comrade of Master John's, who confirms everything and wishes to return thither, because the admiral (for so Master John already entitles himself) has given him an island, and he has given another one to a barber of his from Castiglione, of Genoa, and both of them regard themselves as counts, nor does my lord admiral esteem himself anything less than a prince. I think that with this expedition there will go several poor Italian monks who have all been promised bishoprics, and as I have become a friend of the admiral, if I wish to go thither I should get an archbishopric. But I have thought that the benefices which your excellency has in store for me are a surer thing, and, therefore, I beg that if these should fall vacant in my absence you will cause possession to be given to me, taking measures to do this rather where it is needed, in order that they may be not taken from me by others, who, because they are present, can be more diligent than I, who in this country have been brought to the pass of eating ten or twelve dishes at every meal and sitting at table three hours at a time twice a day for the sake of your excellency, to whom I humbly commend myself.

"Your excellency's very humble servant,

(Signed) "RAIMUNDUS."

"London, December 18, 1497."

The Abbé Raimondo de Soncino (the writer of the above) has made an earlier reference to this matter in a letter § which he wrote on August 24 of the same year to his government. He says:

"Also, some months ago, his Majesty sent out a Venetian, who is a very good mariner and has good skill in discovering new islands, and he has returned safe, and has found two very large fertile new islands, having likewise discovered the seven cities, 400 leagues from England, in the west passage. This next spring his Majesty means to send him with fifteen or twenty ships."

Purchas (His Pilgrimes), writing in 1625, gives another account of this voyage, but it is not to be preferred to that of the Abbé Raimondo, because Raimondo writes before the inception of the second voyage, and also is a contemporary of Cabot, and has had the account direct from him and his companions, whereas Purchas writes from second hand information and more than a century after the time, and may have confused some of the incidents of the first with those of the second voyage. Purchas says:

"In the year 1496, there was a Venetian in England called John Cabota, who having knowledge of such a new discovery as this was (referring to the discovery by Columbus of Hispaniola or of Jamaica), and perceiving by the globe that the islands before spoken of stood almost in the same latitude with his country, and much nearer to England than to Portugal or to Castile, he acquainted Henry VII, then King of England, with the same, wherewith the King was greatly pleased, and furnished him out with two ships and three hundred men, which departed and set sail in the spring of the year, and they sailed westward till they came in sight of land in 45 degrees of latitude, toward the north, and then went straight northward till they came into 60 degrees of latitude, where the day is eighteen hours long, and the night is very clear and bright. There they found the air cold, and great islands of ice, but no ground in 100 fathoms sounding; and so from thence finding the land (now called New Scotland) to turn eastward, they trended along by it, discovering all the Bay and River named Descada to see if it passed on the other side. Then they sailed back again till they came to 38 degrees toward the Equinoctial line, and from thence returned into England. There be others which say that he went as far as the Cape of Florida, which standeth in 25 degrees."

Barrett (Antiquities of Bristol, p. 172) has the following entry: "Newfoundland was found by Bristol men, June 24, 1497 (St. John's Day), in a ship called the Matthew," and this is undoubtedly correct.

Robert Fabian (who died in 1511) says that John Cabot discovered the American continent on June 24, 1497.

Thus we see that Cabot was supported not only by royal authority, but by the pecuniary resources of Bristol merchants; that he sailed in the early part of May, 1497, with three or four small ships, one of which—probably the one in which he embarked himself—was called the Matthew; that after leaving Ireland he sailed westward, and after passing over some 700 leagues discovered land on June 24 of the same year; that he planted the English banner there, and took possession of it in the name of King Henry VII of England.

What was this land? The quantity of fish, doubtless codfish, points conclusively to the truth of what Barrett asserts, that he was in the close neighborhood of Newfoundland; he probably first touched the island of Cape Breton. If he coasted three hundred miles, he would have made a voyage of the Gulf of St. Lawrence, returning home through the Straits of Belle Isle, in which event he would have hugged a very large portion of the coast of Newfoundland. The passage between the southeast point of Newfoundland and of Cape Breton Isle is still called Cabot Straits. On his return he saw two islands on the starboard, but provisions running short he did not stop to examine them. He does not appear to have seen any human beings, but he brought home some fishing tackle and tokens that the land was inhabited.

As we see from the letters of Raimondo, the Bristol merchants were fully persuaded of the possibility of colonizing the new land, and even proposed to establish a fishery on a large scale for the purpose of stock fish.

His son, Sebastian Cabot, was also a navigator,* and it has been suggested that he endeavored to stifle the work done by his father, in order to increase his own glory, and to cause the discoveries made by his father to be attributed to him. Be this as it may, we are able to glean some information concerning John Cabot, even from the son. Sebastian had a map dated 1544 (but whether made really by him, or at an earlier date by his father, is unknown). On this map a legend appears against certain land, which seems to indicate the isle of Cape Breton, and especially that part of it called Cape Percé as being the Prima tierra vista of John Cabot; and the island which John Cabot calls St. John's Isle is probably Prince Edward Island. This legend is written in Spanish, and there is a Latin translation of it, which reads as follows:

"No. 8——John Cabot, a Venetian, also Sebastian Cabot, his son, opened this land, formerly closed to us, in the year from the redemption of the world 1494,† on the 24th day of July,‡ at five o'clock in the morning, which they called the land first seen, and a certain great island opposite to it, which they called the isle of St. John, because it was opened to them on the feast of St. John. The inhabitants of this land § are clothed in the skins of animals, and use the bow in war, arrows, darts, spears, wooden clubs, and slings. The land was sterile and uncultured, and abounding with lions,‖ white bears, and very large stags, innumerable fish—viz., seals, salmon, and great soles of one yard in length, and other different kinds of fish; there is great abundance of them, and the common people call them bacallios; ¶ to them also are dark hawks like crows, eagles, partridges of dark color, and other different birds."

Hakluyt has a similar account of this legend (Voyages, folio edition of 1589), heading it:

"An extract taken out of the map of Sebastian Cabot (cut by Clement Adams) concerning his discoveries of the West Indies, which is to be seen in Her Majesty's Privy Gallery at Westminster, and in many other ancient merchants' houses."

To return to John Cabot. He proposed to return to his new found land, as has been before suggested. On this occasion he obtained new letters patent from King Henry VII, dated the 3d of February, 1498. They recite as follows:

"To all men to whom these presents shall come sending greeting. Know ye that we of our grace especial and for divers causes us moving have given and granted and by these presents give and grant to our well beloved John Kabotto (Cabot), Venetian, sufficient authority and power that he, by him, his deputy or deputies sufficient, may take at his pleasure six English ships in any port or ports or other place within our Realm of England, or obeisance thereto, and if the said ships be of the burthen of 200 tons or under, with their apparel, requisite and necessary for the safe conducts of the said ships, and them convey and lead to the Land and Isles of late found by the said John, in our name and by our commandment, paying for them and every of them, as and if we should in and for our own case pay, and not otherwise."

The letters then proceed to grant permission to the said John Cabot to take with him "such master mariners, pages, and our subjects" as are willing to go to the said land and isles; lastly, these letters command all officers, as well by land as by sea, to be succoring the said John Cabot. It is to be observed that these letters make no mention of his sons, but as a fact he took Sebastian with him. John Cabot was now a rising man. On August 10, 1497, the king had presented him with ten pounds, a substantial sum in those days, in testimony of his discovery. We find this from the Privy purse account of the king: "10th August, 1497. To him that found the new Isle £10." Further, the king granted him an annuity of twenty pounds sterling charged on the customs of Bristol. The order is as follows:

"We let you wit that we for certain considerations Us specially moving, have given and granted unto Our well beloved John Cabot of the port of Venice an annuity or annual rent of Twenty pounds sterling, to be had and paid yearly from the Feast of the Annunciation of Our Lady last past, during Our pleasure, of our Customs and subsidies coming and growing in Our Port of Bristowe, by the hands of Our Customs there for the time being at Michaelmas and Easter by even portion. Wherefore we will and charge you that under Our Great Seal ye do make hereupon Our Letters Patent in good and effectual form. Given under Our Privy Seal at Our Palace of Westminster the Thirteenth day of December, the Thirteenth Year of Our Reign (1497)."

This order is directed by the king to the chancellor, and passed the chancery on the 28th of January, 1498.

John Cabot set sail on his second voyage in the early part of 1498 (probably in the month of June) from Bristol. Very little is known of his second voyage, and, apparently, he never returned. He took Sebastian with him, and it is from the jealous Sebastian that we obtain some few tidings of John Cabot's second voyage. He sailed with three hundred men; one ship put back to Ireland in distress. Cabot steered northwest and came to a coast (probably Labrador) running to the north, which he followed to a great distance. There he found, although it was the month of July, that large bodies of ice were floating on the sea, and that it was almost continual daylight. Having failed to find a passage round this formidable headland, he sought rest and refreshment on the coast of Newfoundland (which Sebastian calls Bacallios, i. e., codfish). Thence he coasted southward, and came about the latitude of Gibraltar, or 36° north, searching for a passage to India. But, the provisions failing, the ships returned to England, whether with or without the illustrious explorer, John Cabot, is unknown. It is clear that his son Sebastian returned to Bristol, and he and his companions (for he suppresses his father's name) had landed in several places, and saw the natives and various animals. The expedition was expected to return to Bristol in September, 1498, but it evidently returned much later.

We glean something of this second voyage from a garbled statement of Sebastian, which is taken* from the sixth chapter of the Third Decade of Peter Martyr of Angleria. Martyr says:

"These North Seas have been searched by one Sebastian Cabot, a Venetian born, whom being yet but in manner an infant, his parents carried with them into England, having occasion to resort thither for trade of merchandise, as is the manner of the Venetians to leave no part of the world unsearched to obtain riches. He, therefore, furnished two ships in England at his own charges, and first with three hundred men directed his course so far toward the north pole, that even in the month of July he found monstrous heaps of ice swimming on the sea, and in manner continual daylight, yet saw he the land in that tract free from ice, which had been melted by the heat of the sun. Thus, seeing such heaps of ice before him, he was forced to turn his sails and follow the west, so, coasting still by the shore, that he was thereby brought so far into the south, by reason of the land bending so much southward, that it was there almost equal in latitude with the sea Fretum Herculeum. Having the north pole situate in manner in the same degree, he sailed likewise in this tract so far toward the west, and he had the island of Cuba on his left hand, in manner in the same degree of longitude. As he traveled by the coasts of this great land (which he named Baccalaos), he said that he found the like course of the waters toward the west, but the same to run more softly and gently than the swift waters which the Spaniards found in their navigations southward. Wherefore it is not only more like to be true, but ought also of necessity to be concluded, that between both the lands hitherto unknown there should be certain great open places whereby the waters should thus continually pass from the east unto the west, which waters I suppose to be driven about the globe of the earth by the incessant moving and impulsion of the heavens, and not to be swallowed up and cast up again by the breathing of Demogorgon, as some hath imagined, because they see the seas by increase and decrease to ebb and flow. Sebastian Cabot himself named those lands Baccalaos, because that in the seas thereabout he found so great multitudes of certain big fishes much like unto tunies (which the inhabitants call Baccalaos) that they sometimes stayed his ships. He found also the people of those regions covered with beasts' skins, yet not without the use of

* Letter found in the state archives of Milan, first published in 1865, in the Annuario Scientifico. Translated by Prof. Bennet H. Nash, of Harvard College.

† I am unable to discover what land is here intended.

‡ Probably Japan.

§ Venetian Calendar, A. D. 1202 to 1509, i, 260.

* See an article, by the late Sir Travers Twiss, in the Nautical Magazine for July and August, 1876.

† This date is wrong, and should be 1497. It is not clear what the object of Sebastian was in giving a false date, unless it be to place a greater distance between his father and him, and to make it appear that he himself was the navigator who commanded in the voyage of 1497.

‡ This should be June; it is so in the Spanish.

§ Sebastian is here speaking from his own knowledge, for it will be remembered that his father found no inhabitants, only traces of some.

‖ Lions not in the Spanish.

¶ He means the common people of Spain, not the savages of the island, as erroneously translated by Hakluyt (Voyages, folio edition of 1589). The world bacallios is the Basque for cod.

* Hakluyt (Voyages, folio edition of 1589) has copied this, from whence we have extracted it.

reason. He also said there is great plenty of bears in those regions which used to eat fish; for plunging themselves into the water where they perceive a multitude of these fishes to lie, they fasten their clawes in their scales, and so draw them to land and eat them, so (as he saith) the bears, being thus satisfied with fish, are not noisome to men. He declares, further, that in many places of these regions he saw great plenty of copper among the inhabitants. Cabot is my very friend whom I know familiarly, and delight to have him sometimes keep me company in my own house. For, being called out of England by the commandment of the Catholic King of Castile, after the death of King Henry the VII of that name, King of England, he was made one of our counsel and assistants as touching the affairs of the new Indies, looking for ships daily to be furnished for him to discover this hid secret of nature."

It is further supposed that the discoveries of John Cabot have been preserved on the map of Juan de la Cosa, a Spaniard, who, in 1500, was supplied by the Spanish embassy in London with a copy of John Cabot's map (now lost). Cosa indicates by English flags the discoveries of Cabot along the North American coast, which appear to range from 50° to 30°—south of Cape Breton to a little south of Cape Hatteras.

In 1583, Sir Humphrey Gilbert, Kt., again took formal possession of Newfoundland in the name and to the use of Queen Elizabeth; for a perpetual witness whereof, he erected on the shore a pillar, whereon the royal arms of England were supported. Several plantations were made from England by virtue of royal letters patent; among others the London plantation in 1611, the Bristol plantation in 1618, and the plantation of Sir George Calvert, Kt., in 1621.

On the 24th of this month four hundred years will have run* since the day on which John Cabot found the new world, and it is desirable that this important event should not be allowed to remain in the quasi obscurity with which it has been surrounded for so long.

We trust that these few pages will prove interesting to our countrymen, and in some small degree help to revive the fame of John Cabot and the glory of the English monarch who sent him.

SHERSTON BAKER.

* June 24, 1497, of course, was the old style, but it is sufficiently close.

The completion of the Chicago drainage canal requires the expenditure of $3,685,648 more than the $28,258,748 now provided for, according to a majority report of the finance committee of the board of trustees recently made public, says Engineering News. This additional amount brings the cost of the canal completed ready for use up to $31,444,397. A minority report of the same committee places the required sum to finish the work at $1,366,191, and with the present state of factional ill feeling in the board of trustees considerable acrimonious discussion has resulted. The majority faction has, however, accepted the minority committee report, and a bill is now being prepared to be submitted to the State Legislature of Illinois, which amends the act of 1895 so that the present tax levy of 1½ per cent. for the construction work of the canal shall continue until 1899, instead of terminating now. The passage of this amendment will, it is believed, be sufficient to provide the $3,685,000 needed to complete the work. It is also the intention of the board of trustees to present to the legislature two other bills, one giving to the board the right to use any part of the waterway of the Illinois and Michigan Canal controlled by the State, provided said waterway is left in the condition it is found in; the other, giving to the board the right to condemn water power now existing, but which later may conflict with the needs of the sanitary district.

Remedy for Caterpillars.—A simple remedy against caterpillars consists of sprinkling with lime the plants affected. The lime is harmless to the plants, but deadly to the caterpillars. Moreover, it is washed into the ground by the rain and dew, and constitutes a good fertilizer.—Wiener Gewerbe Zeitung.

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READING LESSON GIVEN BY A BLIND TEACHER.

BRUSH SHOP.

A LESSON IN NATURAL HISTORY.

METHODS OF INSTRUCTING THE BLIND IN FRANCE.

THE BRAILLE SCHOOL FOR THE BLIND AT SAINT MANDÉ.

WITH the aid of the Société d'Assistance pour les Aveugles that he had founded, M. Pephau, on the first of January, 1883, opened at Maisons Alfort the Braille School, which, first transferred to No. 152 Rue de Bagnolet, in Paris, was afterward definitely installed at No. 5 Rue Mongenot, at Saint Mandé, by the General Council of the Seine, which has made a departmental institution of it.

This school supplies a want that has long been felt by the blind. The child who is admitted to it does not simply receive a very thorough primary instruction, but is developed physically by gymnastic exercises in the open air; and he learns also to like manual labor in passing an hour or so every day in a shop provided for apprentices.

But what care and what abnegation does it not require for such instruction! Of the children taken directly by their parents to Rue Mongenot, how many have been led thither only after a genuine fight of the representatives of the school with the families? It is because a blind child yields a good revenue. No one better than he can draw looks of compassion and good sized coins from passers-by. His infirmity yields receipts. There are professional contractors who exploit him to the great profit of his poor parents. If he enters the Braille School, farewell to all this; the source of an easy revenue is cut off.

Under these conditions the work of the Braille School is not only that of instruction, but, what is doubly difficult, is also disciplinary and social. Its accomplishment requires great intelligence and patience, and especially a genuine goodness of heart and much compassion for human misery. The union of such qualities in all of Mr. Pephau's fellow laborers precisely characterizes the institution created by him, and they exhibit themselves to the visitor as soon as he has crossed the threshold of the school.

See in the corner of the yard that young woman seated upon a very low bench. To her right and left are two very young children of the maternal school recently annexed to the establishment. She is teaching them the Braille alphabet. In the Braille writing, the letters are formed of a combination of dots. The children have to get used to counting the number of these dots and conjecturing the arrangement in order to learn to read. The instructress passes the child's fingers over the page of hieroglyphics with untiring patience, while she plays with the little one and amuses it until she has taught it to find its way in this maze of dots.

The touch is the sense that it is most important to render acute in the blind. This is not all sufficient, however, for hearing, smell and taste have to come to its aid. The development of these senses has to be undertaken methodically and rationally. Before forming an opinion as to the nature and bulk of an object, the blind child has been surrounded with hundreds of elements of observation, and has been taught to remark the hardness, roughness or sonorousness of an object, and then its weight, temperature and dimensions.

In order to attain sufficient precision in the recognition of the things or beings that surround him, the child must therefore devote his senses to numerous preparatory exercises. This is the task of the instructresses. It is facilitated at the Braille School by M. Baldon, the director, who, putting his experience to profit, has grouped in one series of object lessons all the exercises capable of gradually making the development of the blind child's senses as perfect as possible. The study of lines, angles, surfaces and geometrical solids permits of learning the form of bodies by comparison. By familiarizing his hands and mind with various lengths (with sticks of 5, 10, 20, 30, 40 and 50 centimeters or of 1, 2 or 3 meters) and with spaces, the child is easily taught to estimate the dimensions of objects and also distances.

Through unremitting attention, knowing that many bodies have a special sonorousness or that the sonorousness varies according to the surroundings, the child succeeds in distinguishing the size of a room that he enters and the stature and age of the person who speaks to him. The voice, in fact, does not resound in the same way in a small room as in a large one, and does not impress the ear in the same manner coming from above or below.

To the blind everything has to be the subject of observations, such as the rolling of a carriage or of a street or railway car, the sound of a bell, the noise of a waterfall, the song of birds, the cries of animals, etc. Even his feet must furnish him with useful information as to the nature of the ground upon which they tread, whether it is macadamized, paved, etc. But, before the blind child has enough confidence in himself to mingle with life in general, or to participate in such acts of the latter as are capable of interesting him, how many patient lessons, how many wise counsels, and what ingenuity in the processes of teaching!

Nothing is more interesting than the spectacle of a class at the Braille School. To appreciate it, one should see with what rapidity and general accuracy the pupils answer the questions put to them by their mistress, such as those concerning the metrical system or natural history, for example. If a measure of capacity is put into their hands, they feel of it, weigh it with the hand, endeavor to determine the material by the rugosities of the surface and the density, and thrust their hand into it in order to ascertain its depth. If, in a lesson on natural history, any sort of an animal is placed before them, such as a starfish, mole, badger, squirrel, duck, etc., they pass their hands over its body in searching for the eyes, legs, teeth, and, in a word, the distinctive characters of each class and each animal. "This is a palmipede, madam. It has a wide bill; it is a duck," answers a pupil. "Strong legs, provided with sharp claws, long teeth directed forward, teeth sharp behind. It is a carnivorous animal, madam. It is a cat." "And this one?" "That is a rodent, a squirrel."

That a blind person can succeed in identifying an animal by feeling of its body is conceivable. But how he can indicate with precision upon a map or a globe such and such a country, such and such a river or such and such a town is not so easily explainable. In order to obtain such a result in the Braille School, the ordinary maps are replaced by maps in relief on which the principal towns, represented by copper tacks, constitute so many datum points. You can revolve the globe and ask the pupil at hazard to find a city of Europe or Asia, and he will pass his fingers over the surface and locate the places for you at once. In the same way, he will go through the streets of a plan of Paris from one point to another in designating them by name and in telling you what he sees therein, for the blind person says "see" for "touch." Another and very simple method of teaching the pupils of this school the configuration of countries has been found. This consists in putting at their disposal those wooden block maps called games of patience that children who can see amuse themselves with.

The results of such instruction, which have more than once amazed pedagogues, are due in great part to the excellence of the methods and to the personnel whose duty it is to employ them.

Certain natural dispositions of the blind for study merit notice. Although the privation of sight creates an evident inferiority, it nevertheless contributes toward increasing the faculties of reflection and reasoning. The blind pupil has an advantage over the one who can see. He is not distracted, but follows his thought or the instructress's explanation and demonstration, without being diverted therefrom (as is too often the case with pupils who have their sight) by insignificant external manifestations, such as the flight of an insect or the grimace of a companion.

Such concentration of judgment gives a visible imprint to the character of the blind, and likewise serves as a motive to the intervention of their educators. The blind pupil does not care much for play. It is necessary to make him love sports. One succeeds in doing this quite easily, and the spectacle is certainly picturesque in the yard of the Braille School at the hour of recess, with the boys playing leap frog or running without coming into collision, and the girls skipping the rope or dancing.

BASKET MAKING.

Being the issue of parents upon whom poverty has left its impress, the children admitted to the Braille School are mostly of unsound constitution. Frequent gymnastic exercises, either in the yard or in an adjoining gymnasium, contribute toward the physical development of the pupils. At the age of thirteen, the latter leave the primary school for the shop. This they are already slightly acquainted with, since manual labor is included in the programme of the primary school. What will they be taught? Simple trades, but such as will nevertheless gain for them the wherewithal to live upon in independence. Some will make brushes, others will do basketwork, others will cane chairs, and others again will make pearl flowers.

The manufacture of brushes is done in the first story. Boys and girls are occupied in this in the rooms situated to the right and left of a small central shop whence, through glazed windows, the foreman and his assistants can exercise continual surveillance. It is interesting to see with what prudent skill the blind operatives use the cutting instruments, the handling of which is reputed to be dangerous even to those who possess eyesight. The same observation is applicable to the basket workers, who cut, shape and scrape the osier with assurance and without ever injuring themselves. Just as there are boys only in the basket shop, so there are girls only in that in which objects of pearl are made.

The caning shop, which is situated upon the ground floor, is mixed. It receives apprentices of both sexes. In a portion of this hall, a few of the children are employed in the manufacture of straw chairs, and here the beginners at all trades try their hands. The apprentices and operatives are the object of the same attentive care on the part of the foremen and forewomen as that with which they are surrounded in school by the instructresses. The visitor experiences a true feeling of admiration before this beehive of industry where beings that had been seemingly destined to a life of ignorance are producing the wherewithal to assure them a tranquil and proud existence in the midst of a world from which an abyss seemed to separate them.—L'Illustration.

THE DEVELOPMENT OF THE AMERICAN BLOOMING MILL.*

By RALPH CROOKER, Jr.

THE Bessemer and open hearth processes are the survivors of many attempts to produce a cheaper or better material than that produced by puddling.

When these new methods of working iron emerged from the wholly experimental stage and became accepted commercial facts, they found the iron and steel industry already in a highly developed state. The crucible steel process was then about as perfect as it is to-day; while the making of puddled iron, stimulated to the highest degree by the building of railroads—which it had made possible—had reached a point which it has since excelled but little, if any, in quality; although for some years afterward it continued to increase in quantity.

It was to the machinery prepared for the handling of these materials—crucible steel and wrought iron—that the first ingots of the new processes—at first almost exclusively Bessemer—came, to be worked into the shapes that afforded the best market for them, or which stood most in need of such improvement in quality as they offered.

In England, where the greater part of the early development of the Bessemer was done, the ingots were at once sent to the hammer, and submitted to the same treatment as the crucible steel. I am unable to find that any attempt was made to roll it direct from the ingot during the first few years of Bessemer practice; a fortunate circumstance, I think all will agree, who are familiar with the characteristics of that early steel. The product of an English Bessemer works at this time—the middle sixties—was so small—from one to two hundred tons per week—and relatively of so little importance in the large English and Continental works, that the need of machinery especially to care for it does not seem to have been felt. It was a very simple matter to add hammers as the product of the Bessemer works increased, which it did very rapidly; and this was the universal practice, persisted in until the forge department of some of the works attained tremendous proportions, one firm alone having seventy hammers in use before abandoning the system, and making little or no change except to strengthen them and increase the size from four to five, and then to seven and ten tons.

The first to undertake the improvement of this state of affairs was Mr. John Ramsbottom. He undertook to improve the hammer itself, and brought out his duplex hammer, which consisted of two hammer heads moving horizontally toward each other on rollers, the heads being actuated by a steam cylinder through links, the ingot worked upon being placed between the hammer heads, and moved in a direction at right angles with their motion.

Several of these were put in operation, but they do not

* A paper read before the regular September meeting of the Engineers' Society of Western Pennsylvania.

seem to have altogether accomplished their purpose, at least they do not seem to have suited Mr. Ramsbottom, for he shortly afterward introduced his cogging mill, which was one of several devices brought forward at about the same time by different inventors, and the only one of them, so far as I can ascertain, which was ever put in practical use.

This mill in its general features was so nearly like the later blooming mills that one wonders how he managed to miss it. It consisted of a pair of huge housings carrying a pair of arbors, to which were bolted segments of cast iron, forming grooves which went part way around the rolls. The two rolls were made to turn in unison by means of pinions keyed to their necks, and were driven, through very high gearing, by a small reversing engine. The top roll was counterbalanced by a small hydraulic cylinder in the window of the housing between the necks, an arrangement made possible by the great diameter of the rolls—over five feet—and the top roll was forced down by a wedge, driven between the top of the housing and the top box by a hydraulic cylinder, operating through a rack and pinion. The vertical movement of the top roll with this arrangement was, of course, very limited.

While Mr. Ramsbottom was busy trying to correct the faults of his duplex hammer, by building his cogging mill, others, who were using them, were wrestling with the same problem, which was forced upon them by the constantly increasing output of their Bessemer works; and the obvious method of rolling the ingots in the "top and bottom" rolls of their rail mills was tried by several, and with considerable success.

With the English rail mills it was an easy matter to do this, and it may be well here to call attention to the distinct difference in practice existing between the English and American mills of the period (1867), a difference which had come about during the preceding ten years.

Up to 1857 the mills for heavy work—those in America being nearly all rail mills—were the same in both countries, two-high and non-reversing, the piece being returned over the top roll. In this year Mr. John Fritz put in use his hanging guide, which made three-high rail mills possible, and within a few years all the American mills were made three-high.

This was not the case in England, however, where efforts were made to improve their two-high mills by reversing the motion of the rolls between passes, so as to work the piece through the rolls in both directions, the means adopted being five gears and a clutch—many kinds of which were used—and later, reversing engines.

So at the latter end of the decade between 1860 and 1870, the universal practice in America was three-high and in England reversing two-high mills.

It is not surprising, therefore, that in its first blooming mills each country should have followed the form of mill prevailing at home; but so fixed was the difference of opinion as to their respective merits that each country stuck to its own, without a waver, for the next ten years, and without, seemingly, caring to know much about the other.

When it was shown that ingots could be bloomed successfully on the "top and bottom" rolls, larger reversing mills, built especially for the purpose, quickly followed, and several were in use at the end of the decade (1860-1870), although hammering was continued in some works for many years.

America did not begin its modern steel making as soon as England and Europe, nor did it advance so rapidly for some time after it began. There were several reasons for this. We were busy with a great war, which absorbed all our energies, most of our money and many lives, costs of installation and production generally were much greater, and uncertainty and dispute as to patent rights made it hazardous to enter upon such undertakings, so it was 1864 when the first ingots were made at Wyandotte, and they, like those produced abroad at the same time, were hammered. Troy, Pennsylvania, Freedom and Cleveland, the only other producers of Bessemer steel in that decade, all used the hammer for blooming.

It was at the beginning of the decade 1870-1880, when the production of Bessemer steel ingots in America had reached 40,000 tons for the year, that the shortcomings of the hammer began to be seriously felt, and the necessity of building blooming mills forced itself upon the steel makers of this country, and the first works to put a blooming mill in operation was Troy, which rolled its first ingots in January, 1871. This mill, following the general practice of American rolling mills, was a three-high mill, being the first three-high blooming mill in the world, as well as the first blooming mill in the United States. Its top and bottom rolls were fixed, the middle roll was carried in a pair of forged steel bolsters and was moved up or down after each pass by four screws driven from the main engine shaft, by a belt, shafting and worm gearing controlled by a belt driven reversing clutch. The tables on both sides of the rolls were raised and lowered together by hydraulic power. The top of the tables was made up of loose rollers, spaced closely, and on these the two rail ingots were pushed straight for the passes and into the rolls with bars and turned with tongs.

About six months later (July 10, 1871) the Cambria Iron Company put in operation a mill designed by Mr. George Fritz, which had much the same influence on American blooming mills as his brother's earlier invention had had on American rail mills, and fixed the type of mill in almost exclusive use for the decade. This, also, was a three-high mill; but it differed from the Troy mill in having its middle roll stationary, while the top and bottom rolls were movable. The top roll was counterbalanced, and the top and bottom rolls were moved toward the middle one between passes by screws acting together; they were, therefore, only obliged to make the full travel when opening to receive the ingot for the first pass.

The important feature, however, was the tables. These raised and lowered together by hydraulic power, and the tops were composed of rollers arranged to be driven from the main engine by gearing controlled by friction clutches. Combined with this was a manipulator, which consisted of a small car beneath the table with prongs on top of it, extending up through the table rollers when the table was down; this car was moved transversely to any desired position under the table by a hydraulic cylinder, and by lowering the ingot on to the prongs it could be turned, or by pushing the prongs against the side of the ingot it could be moved from pass to pass. This mill was a notable success.

The next year (1872) the Cleveland Rolling Mill Company built a blooming mill which deserves mention as the first reversing blooming mill built in this country and also because it was the only one of its type ever constructed here. It was a clutch reversing mill, and all the auxiliaries, tables, shears and shear tables, were driven from the train engine. As at first put down, it reversed with a three-gear clutch; this was afterward changed to the five gear system. In both cases friction clutches were used, and I believe that no blooming mill has ever been built here that reversed with crab clutches. English practice largely influenced the design of this mill, and at that time the superiority of reversing engines was not established—although it surely was shortly afterward; but that friction clutches were better than crab clutches for reversing was settled. The engineering periodicals and the records of engineering societies for some five or six years, about 1870, are full of illustrations and discussions as to the relative merits of the many devices proposed to overcome the glaring faults of the crab, and are interesting history.

These three mills (Troy, Cambria and Cleveland) may be grouped as the pioneer American blooming mills; but the Fritz mill only needs further attention, the others having had no influence whatever on the design of later mills.

If the manufacture of Bessemer steel in America made slow progress in the decade 1860-1870, it quite made up for it in the first half of the next, eight large works being built on much improved plans. These were all intended for the manufacture of rails, and hardly any other outlet for their product was looked for or expected, the power of new railroad enterprises to absorb the product seeming, at the time, to be almost limitless, while the inferior quality of much of the early steel still cast a deep shadow of suspicion on its reliability for other purposes.

For blooming ingots, of the size then made for rails, it was and is still difficult to improve on the Fritz mill; the size of the ingots not requiring excessive length of tables, and the large section of the finished bloom made it possible to do the work on short rolls of comparatively small diameter.

Under these conditions it is easy to understand why nearly all of these eight works, built between 1871 and 1876, put in Fritz blooming mills, and no other kind of mill had a trial until these conditions changed.

As these mills followed each other in rapid succession, each was an attempt to improve upon its predecessors; but the improvements were entirely confined to minor details. Driving the tables by independent power succeeded various methods of driving from the main engines, operating the table rollers automatically by V friction wheels, engaging when the tables were in either the highest or lowest position, came into use and was followed by a positive drive by means of gears, lazy tongs and reversing engines; the rolls, however, continued to be movable.

The great expansion of the Bessemer steel rail business between 1871 and 1876 was followed by an equally great depression in consequence of the business panic of 1873, and during the last half of the decade very little was done in new Bessemer construction, the efforts of the steel makers being entirely directed toward economical production, and it was these efforts which led to the first departure from what had come to be distinctly recognized as the American blooming mill.

The familiar method of increasing the tonnage was the one almost universally adopted to bring about the desired result, and so successful were the managers of the converting departments in this direction that the product of vessels soon exceeded the capacity of the casting pits to handle it, planned, as they had been, for the work of some years earlier.

Faced with this state of affairs, the Cambria Iron Company, in 1878, determined on a radical departure from the prevailing pit practice, which involved the making of ingots much larger than those in common use, and to care for these they put in a mill which deserves attention, being the first blooming mill in the country reversing with engines, and unique in other respects.

When the Freedom works were built in 1868, a plate mill had been imported from England with a reversing engine, said at the time to be "the best of its class yet produced." It was this mill and engine, with blooming rolls substituted for the original plate rolls, which the Cambria Iron Company utilized to work the large ingots. It was, therefore, an English mill; but the tables, which constituted its chief title to distinction, were American, having been designed by the late Mr. Daniel N. Jones. These consisted of large rectangular frames carrying the gudgeons of loose rollers, the bodies of which rested on solid tracks. These frames, with the rollers, were moved to and from the rolls, through a short distance, by hydraulic cylinders. It will thus be seen that when the table, with the ingot resting on the rollers, was pushed by the cylinder toward the mill, the ingot, moving twice as fast, was

A LESSON IN GEOGRAPHY AT THE BRAILLE SCHOOL.

projected over the end of the table and into the rolls. With this table was combined a manipulator which was very simple and efficient. It consisted of two hydraulic cylinders; one mounted on each side of the table, but independent of it, with the piston rods extending over it and carrying heads so shaped that by forcing them against the ingot it could be turned or moved from one pass to another. A useful feature of this manipulator was that by stopping the mill with the piece in the rolls a crooked bloom could be straightened by forcing one of the heads against it, an important advantage when ingots have been unevenly heated.

The screws of this mill were operated by a small steam engine, and the top roll was counterbalanced by hydraulic pressure.

It is a singular fact in connection with this mill, with a manipulator in successful use, that none of the numerous reversing mills built were equipped with manipulators of any kind for seven years afterward.

While the blooming mills built up to this time had all been in connection with Bessemer works and with a view to rail manufacture, the open hearth process had been steadily developed since 1870, and it is to be noted that from the time when the building of Bessemer works ceased in 1875 until the phenomenal development of new undertakings following the business revival of 1879-80, the building of open hearths was about the only new work done, and the product was at first almost as exclusively devoted to plates as the Bessemer was to rails. The hard times of the last half of the decade forced the Bessemer makers to try to dispose of a part of their steel by rolling their blooms into billets on other mills; at the same time the high quality of the open hearth metal had created a considerable demand for it; but the open hearth makers labored under great disadvantages in getting their material into marketable shape, being compelled to cast small ingots and roll them on the larger bar mills. The Fritz patents had passed into the hands of an exclusive corporation, and the small size of the open hearth works, coupled with the high cost of a blooming mill, made the open hearth people hesitate before putting in so much capital to do so little work.

At last, in 1879, Shoenberger & Company put in operation a reversing blooming mill, in connection with their open hearth furnaces, which was the first to be built except at a Bessemer plant, and also the first to be devoted entirely to the general trade in blooms, billets and slabs.

In this mill the grooves in the rolls were of varying depth, the screws were worked by power from the shears engine through a Hill clutch, and the tables, made of I beam frames and cast iron rollers, were driven and reversed by the train engine direct, through belts. The rolls were driven by a pair of reversing engines which had previously been used on a gunboat, no reversing rolling mill engines having then been made in this country. This mill is of interest, as the experience gained from it was embodied in the design of the one erected at Homestead two years later, thus having a decided bearing on the development of our modern mills, and, furthermore, because on it were made the first four inch billets rolled direct on a blooming mill.

The same reasons which led to the building of the Shoenberger mill caused other open hearth makers to do the same; but so firmly fixed was the superiority of the three-high mill over the reversing mill, in most minds, that the latter received but little consideration. To use three-high mills, however, the Fritz patents must be avoided, and, with this object in view, two mills were built, one for Naylor & Company for billets, and one for the Springfield Iron Company for rail blooms. The peculiarity of these mills was the table arrangement. At the back of the rolls was a table of loose rollers, lifted directly by a jack; on the front side were ordinary hooks, which were raised and lowered by the motion of the back table, but through less distance. A fixed driven roller was placed over the back table in such a way that when the table was raised the ingot was forced against it and thus carried into the rolls.

Another mill should here be spoken of as illustrating the expedients to which steel works managers resorted when the Fritz patents could not be used and before mills reversing with engines were accepted as good practice in this country. It was put in at the Union Works at about the beginning of 1880, and was reversed by the surface friction of large wheels with very broad faces (twenty feet and eight feet in diameter, I think) which were forced in contact by means of a hydraulic cylinder and levers. This mill was afterward replaced by a modern three-high mill, and should be remembered only as taking the place of the last hammers in the business, and as being the last attempt at reversing in any other way than by engines.

With the beginning of the decade 1880-1890 came great changes in the business conditions affecting the steel industry, and these were quickly reflected in repairs, improvements and additions to existing plants and the starting of new enterprises. The tremendous business expansion which began late in 1879 continued through 1880, 1881 and 1882, and the demand for steel works products, especially rails, was unprecedented. This demand came upon works many of which, during the preceding five years, had been run with the least possible expenditure for repairs, and were now driven to the utmost capacity. This usage of machinery quickly made necessary the replacement of several of the earlier blooming mills, while some firms added complete new plants.

In these renewals and extensions the influence of the Cambria practice of large ingots is clearly shown, all the new mills being made larger and stronger, while two mills, a three high at Bethlehem, about 1881, and a reversing mill at Cambria, in 1885, following the decided tendency of the time, were made forty-eight inches in diameter. The conclusion seems to have been reached, however, that equally good results may be obtained from somewhat smaller mills, and none have since been set up of over forty inches.

With this group of new mills the three-high mill reached a fixed standard which we may call the modern three high blooming mill, the first one embodying all its characteristics having been put down at Chattanooga in 1878, and since this time no appreciable change has taken place. In these mills the rolls are all fixed, the tables are raised and lowered by a horizontal cylinder connected with L cranks and links, and the table rollers are driven by an independent reversing engine through gears carried by a lazy tongs.

How thoroughly efficient this kind of mill has proved itself for the making of rail blooms is shown by the fact that in all the new work intended for rail making, in the decade which we are now considering, all but two were of this description—one at Scranton and the other at the Cambria Works. In this latter case the necessity of making various sizes for other purposes than rails largely governed the choice, and it is of interest that this mill replaced the original Fritz mill.

Of the many new enterprises inaugurated during this period, the works erected at Homestead in 1881 by the Pittsburg Bessemer Steel Company, from the plans of Mr. James Hemphill, claim particular attention. This plant, the beginning of the great establishment now located there, was the first Bessemer works especially built to manufacture steel for other purposes than rails; it was also the first to be put in operation after the expiration of the essential Bessemer patent, and in its construction a number of patents, supposed by many to be indispensable, had to be avoided.

In designing the blooming mill the experience gained in the Shoenberger mill—alluded to earlier in this paper—was largely availed of, and several features afterward generally used in American reversing blooming mills were introduced. The mill was driven by the first American reversing engine intended for rolling mill use; the rolls were made with all the grooves of equal depth, thus permitting the adoption of straight table rollers and the making of many sizes on one pair of rolls, and the roll screws were worked by a hydraulic cylinder through a rack and multiplying gear. The tables were constructed with I beam frames and the table rollers were driven by an independent reversing engine, the ingot being handled and turned on the tables by ordinary hooks hung from above, and tongs.

This mill proved itself very efficient, and during the following years many mills of similar character were built, the building of blooming mills receiving great impetus by reason of the change of the material used in cut nails from iron to steel and by the increasing demand for Bessemer billets, which followed rapidly when once they were fairly on the market.

In these mills, about the only changes from the Homestead mill was the substitution of heavy cast iron table frames for the I beam construction, and a simplifying of the table driving gearing.

It was on one of these mills, at the Spang Steel Works in 1885, that the first manipulator after the Cambria one of 1878 was tried, and after that they came slowly into use.

Another mill which should be mentioned in connection with the new enterprises of this time is one which was put to work at Scranton for making rail blooms, in 1888. This mill, with its engine, was imported from England, and is the only complete mill ever brought from there. It was a good sample of the typical English mill of the time; very heavy and with great power. The tables consisted of loose rollers, their necks running freely on rails, and the ingots were handled on these with tongs. This table arrangement, which was never copied by American mills, was replaced some years later by a modern driven roller table. This mill seems to have had some influence in calling attention to what could be done by increasing the engine power of our mills, which was emphasized later by the work of the Sparrow's Point mill.

With the decreasing requirements for rails in this decade, and the ever-increasing demand for steel for other purposes, the three-high mill, except for replacements in rail works, received but little attention. It seemed to be accepted, as fact, that the two-high mill was best where a wide range of work was to be done. It is for this reason that a mill put down at the Otis works, at Cleveland, to combine the advantages of both systems, requires description, being the last of the modifications of the three-high mill.

In this mill the bottom roll was fixed, the top roll was counterbalanced and worked with screws in the same manner as the top roll of a two-high mill, while the middle roll was thrown up and down between passes as in a three-high plate mill; the collars being made extra wide, to support the middle roll, which rested against them when working. The Fritz tables of this mill were thirty feet long, and the only ones of that type ever fitted to a mill for general bloom and billet work.

With the beginning of the present decade practice had become so established that but one mill may be considered as particularly departing from it. This is the Sparrow's Point mill, which is the only thoroughly American reversing mill which has yet been intended exclusively for rail blooms, and is noticeable chiefly for the great power of its engines, which demonstrated the capacity of this form of mill when properly engined; and since the installation there has been a marked increase in the power provided for mills of its class.

The three-high blooming mill reached its highest development at about the time that the two-high mill began its career, and within ten years of its inception; and since that time their number has diminished rather than increased, partly because of a reduction in the number of rail-making establishments, in which field it has maintained its pre-eminence, and shows how thoroughly adapted it was to the purpose for which it was intended.

With the two-high mill it is a story of progressive development for nearly twenty years. We did not begin with this kind of mills until it had been in use abroad for many years, but we availed ourselves little of foreign experience and followed lines of our own, improving and altering our original designs.

The first table frames made of I beams were displaced by cast iron with the bearings cast on; these were followed by built up wrought-iron and cast-iron frames with separate bearings; the present table frame being a substantial cast-iron bed plate with the bearings bolted on, and in some instances water cooled.

Table rollers of cast iron with wrought axles cast in were quickly abandoned for the wrought-iron pipe roller in general use on the three-high mills; then came the steel casting with the necks cast on, and to-day the preference is divided between these and a roller made of a cast-iron body fitted with a forged axle.

The driving of the table rollers began by taking power from the main engine, which was soon changed to the use of a separate engine driving both tables together through a countershaft; and finally the countershaft has been done away with, an engine coupled directly to the line shaft being used for each table. At the same time there has been a steady improvement in the table gearing. In the earlier mills the rollers were divided into groups driven by spurs and idlers; the number of these has been gradually reduced until each separate roller is now driven by a miter gear, and there is not a single intermediate gear or countershaft of any kind in the best mills.

Manipulators, after a few trials, superseded the old-fashioned hooks and tongs, and since 1890 have been in general use. In this matter alone there seems still to be a difference of opinion, and some half dozen kinds have their advocates.

In the mill itself, we have finally widened the windows of the housings so that the rolls may be changed through them; and we now generally use hydraulic counterbalancing for the top roll—methods which have prevailed in other countries from the beginning, but which we reached rather by evolution than by imitation. For working the roll screws there has been but slight change since hydraulic power took the place of belts and engines, although electric motors are used on some mills requiring extraordinary lift to the top roll.

The early mills were driven by engines with gearing of three or four to one; these ratios have been steadily cut down until gearing has been abandoned, and the latest mills are connected directly to the crank shaft.

It seems as though the work of simplifying the two-high mill has about reached its limit, and, like the three-high mill of fifteen years ago, there is little room left for further improvement.

THE LOUITON FLOAT.

THE LOUITON FLOAT FOR SWIMMERS.

The Louiton float, which is represented in the accompanying engravings, consists of a long bag made of sheet rubber, and which, when inflated, assumes a cylindrical form with conical extremities. At each end of the float there is a long leather attachment. Each conical extremity terminates in a narrow tubulure, which is closed by a wooden plug. This float is inflated with the mouth, and quite rapidly, too; say in less than a minute. It is afterward wound about the body, as shown in the figures. The dimensions of the apparatus are as follows: Cylindrical length, 3 meters; diameter, 5 centimeters; length of the conical extremities, 5 centimeters; internal diameter at the summit, 5 centimeters; length of tubulures, 4 centimeters, and

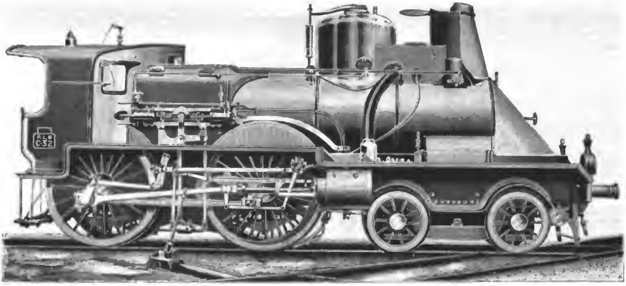
the diameter the same as that of the conical extremity. The thickness of the bag, which is uniform, is one millimeter. The total weight is exactly 520 grammes.

This float for swimming may, if need be, be made longer or shorter and have capacities of 10 and even 15 cubic decimeters. The thickness of one millimeter, although sufficient, may be doubled, if necessary. The plugs are of hard, turned wood, and taper at one extremity. In order to insert them into the tubulure, they must be wet and introduced with a screwing motion. This float is very useful. It permits any one to learn how to swim, and assures rest and safety to bathers, swimmers and others.

Experiments have shown various advantages: It is very simple, very flexible, quite strong and light, and may be easily carried, be quickly repaired and easily placed upon the body. It does not interfere with respiration, the wearing of it is attended with no inconvenience, and those who have tried it agree in the statement that it is very practical and may be recommended to swimming schools.—La Nature.

A NEW FRENCH LOCOMOTIVE.

THE remarkable contour of the locomotive we illustrate on this page needs no comment. From time to time persons forget that the end friction of elongated bodies moving at high velocities is practically negligible when compared with the side friction, and attempt to reduce resistance by providing the body with a pointed beak or prow, even at the expense of increased surface. It is true that projectiles are pointed at the leading extremity, but it has been shown by experiment that the gain in velocity from so doing is only slight. The projectile, however, flies more steadily, and it is therefore pointed. An elongated projectile with a hemispherical end, but tapering toward the rear extremity, is about as good for flight as any. The porpoise very closely follows this shape, and perhaps the great speed attained by this animal is dependent in large measure upon it. The locomotive is the first of forty constructed to the designs of M. Ch. Baudry, for the Compagnie Paris Lyons-Méditerranée. It is compound, having two low pressure and two high pressure cylinders, the latter being outside the frames, and the steam which is conducted to the chest by the exterior tubes—one of which is seen—is distributed by Walschaert's valve gear. The low pressure cylinders beneath the boilers are, for the sake of saving room and labor, provided with Gooch link motion. There are two entirely independent reversing gears. A large number of experiments has been made with several of these engines, but more with a view to testing the value of different points of cut-off in the high or low pressure cylinders than for the attainment of very high speeds, no very fast running having so far been attained with them.—The Engineer.



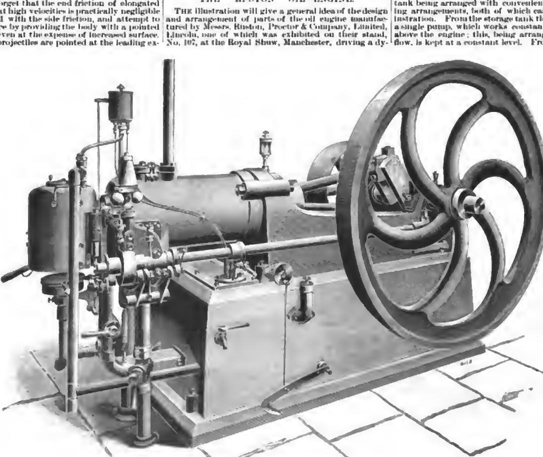
EXPRESS LOCOMOTIVE, PARIS-LYONS-MEDITERRANEAN RAILWAY.

THE "RUSTON" OIL ENGINE.

THE illustration will give a general idea of the design and arrangement of parts of the oil engine manufactured by Messrs. Ruston, Proctor & Company, Limited, Lincoln, one of which was exhibited on their stand, No. 107, at the Royal Show, Manchester, driving a dynamo and supplying the current to the "Royce" motors and machines on the adjoining stand occupied by Messrs. Royce & Company, Manchester.

There has been in the past, and there still remains, much prejudice against oil engines which ignite their charges automatically by the evolved heat of combustion, but the fault has not been in the principle of automatic ignition, but in the means which makers have adopted up to the present to produce it. In the "Ruston" engine this extremely convenient method of working is so perfectly arranged that the engine is able to run and sustain its igniting temperature equally well under all conditions of load, and has actually been run unloaded for three and a half hours under precisely the same conditions as when working with the full load. Messrs. Ruston, Proctor & Company inform us that during all the experiments, which have been very exhaustive, they have not known this engine to miss an ignition or to "back fire," as the objectionable explosion in the exhaust due to the missing fire is termed.

The engine works on the usual four-stroke cycle, and in governing cuts out such charges as are not required. By tracing the oil in its passage through the engine the working will be more clearly understood. The oil is stored in the base plate of the engine in a tank of sufficient capacity for a day's run at full power, this tank being arranged with convenient filling and drawing arrangements, both of which can be seen in the illustration. From the storage tank the oil is elevated by a single pump, which works constantly, to the cistern above the engine; this, being arranged with an overflow, is kept at a constant level. From the cistern the



RUSTON, PROCTOR & CO.'S OIL ENGINE.

petroleum is measured out in exactly equal amounts for each charge by a measuring device which can be changed, without stopping the engine, to suit different varieties of petroleum. The measuring apparatus delivers the oil charge at the right time down a tube leading to the vaporizer through the bottom of cistern.

The vaporizer itself is a spiral passage surrounded by an extension of the combustion chamber in open communication with the cylinder, the vaporizer receiving sufficient heat from the explosion within the extension of the combustion chamber to perfectly vaporize the oil charge. The petroleum is drawn through the vaporizer at atmospheric pressure, being followed and swept through the vaporizer passages by a current of air which insures the whole of each charge being delivered to the engine.

Upon the same extension of the combustion chamber, mentioned above, a simple cast iron ignition tube is placed, which, after heating up at starting, is kept at a dull red heat by the explosion within it. The ignition tube and passages surrounding the vaporizer and leading to the combustion chamber are so arranged that the products of combustion are cleared out and mixed with each incoming charge, this arrangement entirely preventing the carbon deposit which collects in the combustion chambers of so many oil engines.

The lamp is of the simplest construction, consisting of two pieces of cast iron, a dish and a cover, with an indestructible wick, by means of which the petroleum is lighted, obviating the necessity of putting in lighted waste or other makeshift, an uncleanly means of starting the lamp. A small fan, with a convenient treadle driving arrangement, feeds a blast of air to the lamp, which holds just sufficient oil to heat the vaporizer and igniter to the right temperature, and gives a number of fierce and distinct flames meeting together upon the ignition tube and vaporizer, enabling the preliminary heating to be accomplished in six or seven minutes. The engine can, therefore, be started and at work inside of ten minutes from entering the engine room.

The vaporizer and igniter are inclosed in one common cover provided with ventilating arrangements, by means of which the temperature of the vaporizer can be regulated should circumstances require it, though it is found this rarely needs adjustment, since the temperature is sufficiently sustained under all circumstances, and premature ignition is prevented by the amount of mechanical movement to be accomplished by the flame in traveling from the igniter to the main portion of the charge.

The convenience, safety and freedom from smell in having no lights which are supposed to burn constantly, but which frequently go out, either being blown out or stopped by dirt clogging up the fine holes necessary in such lamps, will be readily understood and appreciated. The vaporizer is never red hot or anything approaching it, being kept at a very moderate temperature, the igniter alone being so arranged that it approaches to a red heat.

The whole engine is extremely simple, easily started, and requires practically no attention. Where access to valves may at times be necessary or advisable metallic joints and convenient covers are arranged which can be quickly removed, so that every working part of the engine can be taken out, examined and replaced in a few minutes. As to the consumption of oil, the makers state that they have found the oil used per brake horse power per hour to be less than three-quarters of a pint of common Russian petroleum under suitable conditions and load in the medium and larger sizes, the smaller ones using a little more.

The engine can be arranged for use with any commercial petroleum of specific gravity from 0·79 and upward with very trifling changes, and the same oil is used in the lamp at starting as that burned in the engine. Messrs. Ruston, Proctor & Company are prepared to manufacture these engines in any size up to twenty brake horse power, and to supply similar engines to work with coal gas.—Engineering.

[Continued from Supplement, No. 1137, page 18169.]

PERPETUAL MOTION.—VII.*

Fig. 29 is a diagram sent us by Mr. William B. Cooper, of Philadelphia, who writes as follows in regard to it:

"Having seen in a previous issue a diagram of an attempt at perpetual motion, by H. Leonhart, I send you the inclosed diagram and description, which appears to me to correct the errors in his. The diagram represents an upright tank, through which passes a number of floats connected by a band of elastic rubber attached to their ends, leaving just enough space between them to secure action on each side by the water. They are each of the same weight as an equal bulk of water at the surface, therefore the upper one in the tank has no comparative weight. The next lower one has a unit of upward force equal to the condensation of its bulk of water, and so on, each adding a unit to the upward tendency, until we come to the last, the pressure on which is altogether downward to the amount of the entire column of water; but we already have a number of opposing upward forces, and when we look on the other side and see the thirteen active weights, it seems clear that there will be a large surplus weight, over and above the opposing weight and the friction of the rollers and upper wheel.

"Of course mercury or any other liquid could be substituted in place of water.

"If you can, by the inclosed rough diagram and description, comprehend my meaning, I would consider it a special favor if you would point out the error, if any."

The mistake of this invention is in supposing the upward pressure of the floats, added to the weight of the floats outside the tank, will more than equal the weight of a water column having a base equal to the lower side of one of the floats, and a height equal to the depth of the tank. If the floats be made of material more compressible than water, they would tend to sink rather than rise in the tank, but if made of material less compressible, the amount of upward force which could be obtained by their compression would be far less than the weight of water in the interstices between the floats. The downward effective pressure on the lower float in the tank would be the difference between this buoyancy and the weight of water in the interstices between the floats. The weight of the floats outside the tank is exactly balanced by the downward pressure of a bulk of water equal to that displaced by the floats in the tank, therefore if any motion should take place at all, it would be in an opposite direction from that expected, and would only continue till enough water had passed out of the bottom of the tank to bring the parts of the machine in exact balance.

We this week conclude our series of articles upon perpetual motion with an illustration of a machine,

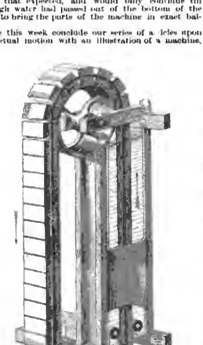


Fig. 29.

invented by a Canadian inventor, and a couple of letters upon the subject, lately received.

Fig. 30 is the device above referred to. It consists of a cylinder containing a fluid, with two or more weighted rods passing through stuffing boxes in the shell. To the middle of each of these rods is fixed a ball of cork which is expected to rise to the upper side of the cylinder whenever the revolution thereof brings it a little below the axis of the cylinder. In thus rising, it will carry the upper weight away from the center and bring the lower end toward the center, so that it is thought the center of gravity of cylinder arms, corks and metallic balls will be kept constantly on one side of a geometrical center, and constant revolution will result. The fact is, however, that the center of gravity will remain always in a perpendicular drawn through the axis, and, consequently, the expectations of the

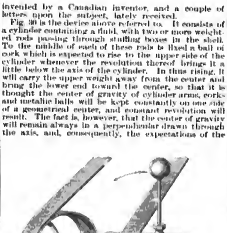


Fig. 30.

inventor will never be realized. Even if the movement of the arms expected to occur should take place when the cylinder is turned by hand, the decrease of weight on that side of the cylinder to which the cork would rise, caused by the displacement of the heavier fluid, and the increase of weight on the opposite side, caused by the displacement of the cork, would counterbalance the leverage of the weighted arms, and so the exact balance of the machine would remain undisturbed.

Messrs. Editors: This communication is especially designed for the benefit of those who still believe the perpetual motion of machinery possible. Let it be granted that the terms weight and force are synonymous, i. e., twenty pounds of weight will require a force precisely equal to the force of its own pressure to sustain it, or neutralize that pressure. For example: If a twenty pound weight be placed upon a scale, and a hand be placed upon the opposite scale, the force applied by the hand must equal twenty pounds to exactly balance the twenty pounds.

So far we only affirm what every schoolboy is aware of.

Keeping strong hold upon this self-evident fact, we may next affirm that each twenty pounds is at an equal distance from the center pin or fulcrum of the beam. Observe also this additional fact. If either weight be depressed, the opposite one will rise at the same speed and through the same distance which the other has fallen; i. e., equal weights will balance each other, at equal distances from a common point of support, and will move in opposite directions with equal velocities.

Suppose it be required that one of these weights shall rise faster than the other falls. To accomplish this, we must remove it further from the fulcrum or point of support. Observe that a scale beam corresponds to the diameter of a circle, and the arms to the opposite radii of the circle. To the unscientific, these self-evident definitions may appear puerile; but let them reflect that the grandest theorems of scientific investigation wholly depend upon a recognition of self-evident truths.

Returning again to what was proposed, viz., to cause weights at the extremities of a lever to move at unequal velocity, we find that to do so they must describe arcs of different circles, as the radii are unequal.

But in removing one weight farther from the fulcrum than its opposite we destroy the balance; for example, suppose its distance to be double that of the other, it will now move with double velocity, but will require first double weight or force at the opposite end to balance it; in other words, "all that is gained in velocity must be replaced in force at the opposite end of the beam."

The converse of this is true; i. e., we may cause a weight to raise a greater, as already shown, but if we raise forty pounds with twenty, we only raise it half the distance which the twenty pounds falls.

The above being the essence of the "law of virtual velocity," needs only to be comprehended to entirely explode all possible theories of perpetual motion.

Every attempt to produce a self-moving machine has been in open defiance to the co-ordinated relations of force and motion, and any man who comprehends this law of velocity will no sooner attempt to solve the problem of perpetual motion than to climb upon his own shoulders as a higher point of observation.

I do not propose to exhaust the numerous theories in support of the fallacy, but will analyze a few, serving as a death knell to all.

Before attempting this, let us remark that, in the search for an impossibility, so many valuable and practical certainties have been demonstrated that perhaps no time has absolutely been thrown away, for as alchemy has fostered and developed chemistry, so has the search after perpetual motion taught how to apply force through complicated machinery, and thus through unsought channels has knowledge and civilization flowed all over the world.

A favorite device of the "perpetualists" is one which proposes to employ an overshot water wheel, that shall pump or convey the water back to a reservoir as fast as it comes out. To accomplish this it only becomes necessary that all the water shall move in equal volume or weight and equal velocity in a given circle, or at opposite ends of the scale beam. A simple recognition of the principle laid down at the beginning of this article demonstrates that this is absurd.

The supporters of this species of nonsense occasionally propose to lift this water above the highest point of the circle. As this supposes the less to exceed the greater, it does not require refutation. The foregoing reasoning applies with equal force to all combinations of tubes and endless chains, belts, cups, etc., proposing finally to act upon a given circle and to be lifted back to their proper positions to continuously act upon a greater circle, or longer set of levers. These simple facts set forth, that equals can only balance equals when acting oppositely at equal distances, completely upset all possible theories of perpetual motion. But a few days since, one of this class of enthusiasts called upon the writer with a rude drawing, in which appears some half dozen geared wheels with about an equal number of mystical appearing levers, by which he exultingly proposed to propel a first class steamship across the Atlantic, by employing one man at a crank turning a geared wheel two feet in diameter. Of course, I dissented, but his faith was sublime; and he left, evidently disgusted with my shortsighted ignorance and mechanical bigotry. And so it will continue until minds of this class pause and observe a few simple and obvious truths, which, clearly recognized, make the theory of perpetual motion to fade like "the baseless fabric of a vision, leaving not a rack behind."

I. D. J. Sweet.

A humorous correspondent gives the following as a method whereby a perpetual motion may be obtained. He says he has seen a steam boiler advertised which saves 33⅓ per cent. of fuel; a valve which saves 15 per cent.; a governor which saves 10 per cent.; a cut-off which saves 10 per cent.; a fire grate which saves 20 per cent.; metal packing and damper regulator which saves 12 per cent.; and a lubricator which will save 1 per cent., making in all a saving of 101 per cent. Combining all these improvements, an engine would, he thinks, run itself, and produce an additional one per cent. of fuel, which might be used for domestic purposes.

(Conclusion.)

A motor chaise was proceeding across Ludgate Circus, London, when the driver, a young man, apparently noticing something going wrong with the car, turned it in the direction of the King Lud public house. There was then a loud explosion, which caused considerable consternation among the passers-by. The car immediately began to "run wild," but the driver preserved his presence of mind and managed to steer it against the curb. It was then discovered that the cylinder containing naphtha had burst. Fortunately, the naphtha which escaped did not ignite, and therefore an accident of a serious kind was averted.

* Reprinted from the Scientific American, 1870-71.

ENGINEERING NOTES.

A new batch of 30 knot torpedo boat destroyers is being turned over to the British Admiralty. Palmer's Chamois made 30·4 knots in the three hour trial, the highest speed on the mile course being 32·37 knots. Thornycroft's Mallard made 30·2 knots.

There was a collision on the Danish State Railroad near Copenhagen some time ago in which forty persons were killed and seventy wounded. The railroad at once admitted that it was to blame, and instead of fighting claims for damages, has appointed a committee to settle with the claimants what will be fair compensation, so as to avoid having the claims brought into the courts.

The installation of a railway line from the Caspian Sea to the Persian Gulf is at present under consideration. There are no great technical difficulties in the way of the enterprise, but it seems doubtful whether the Shah of Persia will consent to a step which will place his territory under the power of the great empire of Russia, nor can it be a pleasing prospect for England to know that Russian troops could, in case of the line being built, arrive at the Indian Ocean from Moscow within a week.—Uhland's Wochenschrift.

The only street railway in the entire province of Mozambique, Africa, is located in the town of Beira, writes United States Consul U. Stanley Hollis. This railway is about 2 miles in length, built on a 24 in. gage, and its entire rolling stock consists of one flat hand car capable of seating four people. Its motive power is from two to four stout Kaffirs. The Beira Tramway is owned by the Companhia de Moçambique, of that place. There has been some talk of a tramway at Lorenzo Marques, Delagoa Bay, but as yet nothing has been done.

Tests recently made on molybdenum steel by Prof. W. von Lipin, of St. Petersburg, show that molybdenum steel resembles tungsten steel in a general way, although it is less affected by annealing and tempering, says The Engineering and Mining Journal. Annealing makes it softer than tungsten steel; high heating, on the other hand, makes it harder than the latter. This steel can stand treatment in the fire as well as tempering better than tungsten steel, and shows no fissures where tungsten steel very often does. This may be the cause for the numerous attempts to substitute molybdenum steel for tungsten steel, and especially chromo-tungsten steel.

Lord Kelvin, in his recent address before the British Association at Toronto, gave some estimates on the available fuel supply of the world and made some suggestions which attract attention. He thinks that the utilization of water powers to the greatest extent will diminish only insignificantly the tax on the world's supply of fuel, and believes that the cultivation of vegetation which adds to the store of oxygen is of more importance than anything else man can do to prolong human life on the earth. He estimates that there exists 510,000,000 million tons of oxygen that will burn 340,000,000 million tons of fuel, but the diminution of the oxygen will destroy human life long before its supply gives out, so that the fuel that may be left after the race dies is of no avail. There are 200,000 tons of fuel for each person living to-day, which, he says, will limit the life of the race to a comparatively short span. But the growth of vegetation will be necessary to sustain life to this limit. Lord Kelvin calculates that the power now developed from the turbines at Niagara is only equivalent to the requirements of about ten ocean liners, and if the entire force of the mighty stream should be utilized, it would only be equal to the power of 100 of these ships.

The view from the Gorner Grat is considered to be the most magnificent in Europe. Monte Rosa looks close at hand, while the Matterhorn is so near that apparently one might throw a stone on it. The Gorner Grat railway, which, it is hoped, may be ready for traffic next year, will have its terminus at the summit, 10,000 ft. above the sea level, the greatest altitude yet reached on rails on that side of the Atlantic. It will start from Zermatt, where it will be connected with the branch of the Rhone Valley railway, which, in 22 miles between Visp and Zermatt, rises to the height of 8,160 ft. The new line consists of 9½ kilometers of rack and pinions, climbing the Riffel Alp to the Gorner Grat. Difficult corners are avoided by spiral tunnels having entrance and exit on the same rock face. About a mile from Zermatt it crosses a gorge by a remarkable bridge. The torrent will be utilized to furnish motive power, for the line will be on the trolley electric system. It has been only possible to carry on the construction for four and a half months in the year, and the traffic will be limited to a three months' season, as both railway and machine house will be mostly under snow for the remainder of the year. Under these circumstances the fares will be high, but people who want the luxury of a railway up a 10,000 ft. Alp must expect to pay for it.

The first light railway in England is now open. It connects Chichester with Selsey. The gage is 4 ft. 8½ in., which enables a junction to be formed between it and the London, Brighton and South Coast Railway. There are four stations on the line, but we hope they are only temporary and that the traffic will allow of the erection of more fitting examples. The canal is crossed by a drawbridge. At present the line terminates at a point about 300 yards distant from Selsey Church, but it will be advantageous to extend it before next summer for about half a mile, in order to bring visitors nearer the sea. One of the objects of the tramway is to facilitate communication with Selsey, which is likely to become a popular watering place. The success of the experiment depends in a great measure on the locomotives. The company were wise when they gave the commission for the two required to Messrs. Peckett & Sons, Atlas Locomotive Works, Bristol. The Chichester and the Selsey were specially constructed by this firm for mixed traffic, such as they are likely to have on this line. The Chichester is a six-wheeled engine (four wheels coupled) and the Selsey four wheels coupled, with a two-wheel pony truck at each end, so that the weight is distributed. In consequence, a light rail is able to be used and economy is secured. The working of the line will be watched with much interest, and it is not unlikely that from other districts orders for similar locomotives will arrive.—The Architect.

ELECTRICAL NOTES.

Brooklyn has 12,994 street gas lamps and 3,431 electric lights, says The Electrical Review. The total cost of the gas for the streets and public buildings for the year 1896 was less than $185,000, while the electric lights cost $357,698.

Germany and Spain are now connected by a submarine cable 1,250 miles long, the ends of which are at Emden and Vigo. It is the first link in a series of lines to be first extended to Brazil and to the United States by way of the Azores.

Dr. Jameson, of Transvaal fame, has taken charge of the construction of the transcontinental telegraph line across Africa from north to south. For the present it will not extend beyond Lake Tanganyika, says The Electrical Review.

An electric railway is to be run between Debreczin and Nagyvarad (Hungary), a distance of 38 miles. It will be the longest electric line of Europe. Debreczin and another town are at the same time to be supplied with electric light.—Electrotechnische Rundschau.

Prof. Crookes made the astonishing discovery that a diamond inclosed in a Crookes tube became covered with a black film. M. Moissan has investigated this film and has found it to be graphite. Further explanation is not forthcoming.—Electrotechnische Rundschau.

The electric street car line in Bernburg (Anhalt, Germany), was opened on May 1. It is the first electric tramway in the Duchy of Anhalt, and was built by the Allgemeine Electricitäts-Gesellschaft, of Berlin, Germany.—Electrotechnische Rundschau.

An experiment in the electric lighting of railway carriages is being carried out by the London and Northwestern Railway Company on its suburban line between Euston and Watford, says The Electrician. Each carriage is treated independently, having its own dynamo driven by gearing from one of the axles, and a set of accumulators to provide current when the train is not in motion. The Caledonian Railway Company is also experimenting with electrically-lit carriages on its Edinburgh-Glasgow line.

According to The London Electrical Review, an interesting process is now being conducted at Charlottenburg, Germany, by M. Mehner, by means of which ammonia and nitrides are produced. Oxygen compounds of such elements as boron, silicon, magnesium, titanium and vanadium, capable of combining with nitrogen at high temperature, are exposed to the heat of an electric furnace in the presence of free nitrogen and carbon. A high tension current must be employed and a jet of sand blown in while generator gas is introduced; on entering the hot zone of the electric furnace the sand is said to evaporate and then acts as desired. Nitrides thus manufactured may be treated with steam to obtain ammonia and an oxide from which a nitride may be reformed as before.

A novel electric elevator has been invented by H. Russell Smith, engineer of the Winslow Brothers Elevator Company, Chicago. It is stated to fully meet the exacting requirements of modern tall buildings and is styled an electromagnetic elevator, from the method of applying the power. Electrically driven elevators usually consist of steam or hydraulic elevator machinery operated by an electric motor of some variety. In this case, however, the solenoid, or coil and plunger, is used to apply the power to move a car. The inventor claims that in his form of apparatus there is far more to entitle it to the name electric than in any other style of elevator in use. An elevator built upon this principle is in successful operation in Winslow Brothers' factory.—Iron Age.

The rates of speed for street railway cars, as established by the ordinances and franchises in different cities, are as follows in and out of city limits, says The Electrical Engineer: Albany 12 miles per hour, Binghamton 12 miles, Brooklyn 6, 8 and 10 miles, Buffalo 12, 15, 18 and 20 miles, Elmira 7 and 15 miles, Rochester 6 and 12 miles, Allegheny (Pa.) 15 miles, Omaha 10 and 15 miles, Grand Rapids 7 and 15 miles, Washington 6, 12 and 15 miles, Boston 7, 10 and 12 miles, Denver 9 and 15 miles, Des Moines 8 and 12 miles, Columbus (O.) 8 and 14 miles, Dayton (O.) 10 miles, Evansville (Ind.) 12 miles, Kansas City 12 miles, Louisville 10 and 12 miles, New Haven (Conn.) 10 and 12 miles, Paterson (N. J.) 10 and 15 miles, Providence (R. I.) 9, 10 and 12 miles, Rochester 7 and 15 miles, St. Louis 10 and 12 miles.

Of the German telephone newspaper, described in these columns some time ago, The Electrical World speaks as follows, its authority being a German technical paper: "News is distributed continuously by telephone during the whole day, including some entertaining matter in the evenings, among which is always the overture at the opera house whenever there is a performance. It appears from the programme that stock quotations are given for 15 to 20 minutes about every hour or two; every few hours there is a review of the principal news items that have been transmitted before; the number of subscriptions has at present reached 6,000, including a length of wire amounting to 360 miles; it is stated that it is now possible with the apparatus in use to transmit simultaneously to 20,000 subscribers with sufficient loudness."

It is reported that a crucial test of compressed air as a possible rival of electricity has been made in a Colorado mine, says The Western Electrician. The tests extended over a month, and were made in every case under exactly similar conditions. Two small electric pumps and an air pump were placed side by side in an entry 10 ft. wide by 5 ft. high, with the exhaust of the air pump, into which a stream of water was discharged to prevent it from freezing, venting so near the electric pump that it was necessary to protect the latter from the water by an oilcloth. This was a good test for the waterproof properties of the motors. The result of the trial showed that the work of pumping by compressed air, which had formerly called for 812 horse power and eight boilers, could be done by electricity with but 56 horse power and one boiler, disregarding even the use of a compound engine and a condenser. In other words, the whole plant of pumps and machinery heretofore requiring eight boilers, taxed to their utmost, can be operated by a modern electric plant, with but one horizontal tubular boiler. The total efficiency of this electric pumping plant is estimated as close to 73 per cent.

MISCELLANEOUS NOTES.

On the Glasgow underground railroad the experiment was recently tried of doing away with tickets and letting people ride as far as they wished for a penny. On the first day of the trial, however, many persons got into the cars and spent the day riding round and round. The directors did not have the patience to wait for the novelty to wear off, but restored the ticket system after a week.

According to recent French statistics, France lost 136,000 men by death through wounds, sickness or accidents in her war with Germany, while 139,421 men were disabled on the field of battle. Germany's losses were 79,155 dead and 18,543 wounded. The monetary loss is more evenly divided, that for France being 12,666,487,522 francs, and that for Germany being 8,000,000,000 francs.

Bohemian sportsmen, during the year 1895, shot and killed 30 men, women and children and wounded 2,194 persons, chiefly gamekeepers. They also killed, among other game, over 15,000 dogs, 8,762 cats, 2 horses, 15 cows, 132 calves, 276 goats, and 129 sheep. For this they had to pay collectively over $500,000 for doctors, fines and indemnities, and to spend 74,398 days in jail. The Austrian government collects the statistics.

An apparatus, called thermophone by its inventor, is devised for finding high temperatures, and is constructed on quite a novel plan. It consists of a clay receptacle, which is filled with some explosive substance. The article whose temperature is to be measured is brought near the thermophone, and, according to the time which elapses before the explosion takes place, the temperature may be found from tables drawn up by the inventor.—Uhland's Wochenschrift.

In Germany there is no special classified duty on bicycles, the small amount paid on wheels being only that due on steel. About 1 per cent. of the value of a bicycle is paid, while in other countries the customs are from 35 to 50 per cent. The German authorities are, however, considering the levy of a special duty on bicycles imported, as the present state of things greatly tends to increase the importation of foreign goods to the detriment of home manufacturers.—Uhland's Wochenschrift.

The latest returns of the British Board of Trade show that in 87 tin plate works 272 mills were at work, as compared with 278 at the end of June and 308 at the end of July, 1896. The number of works giving full employment decreased during July from 39 (with 212 mills) to 36 (with 191 mills), while works giving partial employment increased from 16 (with 68 out of 99 mills at work) to 18 (with 81 out of 116 mills at work). The number of works entirely idle at the end of July was 33 (with 172 mills), as compared with 32 works (with 168 mills) at the end of June. The continuance of trade disputes again accounts in some measure for the stoppage of mills. Returns received from owners of 55 tin plate works show that 19,772 persons were employed at the end of July, being 365 less than at the end of June and 1,975 less than at the end of July, 1896.

The deterioration of paper is a subject of primary importance, in view of the desirability of preserving permanent records, and it is well known that the material employed for many books and periodicals is, perhaps fortunately in some cases, not of such a nature that it may be expected to survive constant handling during many years. Care ought to be exercised, therefore, in selecting paper for printed matter that may require to be frequently referred to during a prolonged period. The Council of the Society of Arts is awake to these facts, and has appointed a committee to investigate the causes of the deterioration of paper. Pharmacy is represented on this committee by Mr. Michael Carteighe, the other members being Sir Owen Tudor Burne, Sir William Anderson, Mr. C. F. Cross, Sir John Evans, Dr. Richard Garnett, Dr. Hugo Müller, Dr. W. J. Russell, Mr. W. L. Thomas, Prof. J. M. Thomson, Mr. Henry R. Tedder, Dr. Quirin Wirtz, and Sir Henry Trueman Wood. This is a goodly company, and the result of the investigations to be pursued should be of world-wide interest.

Municipal ownership of gas plants in Great Britain and Ireland is said by The London Contract Journal to prevail in 208 municipalities, while there are 437 private companies. The ownership by countries is given as follows:

	England and Wales.	Scotland.	Ireland.
Municipal	160	36	7
Private	426	2	9

The same journal gives the paid up capital of the companies as about $225,000,000, and the sums borrowed by the municipalities as about $125,000,000. The total amount of coal used is given as 11,917,440 gross tons, with an output of 121,422,000,000 cubic feet of gas, of which 111,000,000,000 was sold during the year ending March 25, 1896. The mileage of mains on the date named was 23,857, supplying 2,659,771 consumers' premises and 326,898 public lamps. The gross yearly receipts of the companies is given as about $80,000,000, and of the public plants at $30,000,000, with respective expenditures of about $45,000,000 and $20,000,000.

Terrific detonations are heard down the Schuylkill Valley on nearly every week day, from morning until night. In a secluded ravine near the Reading Railroad the Monocacy Blasting Company is breaking up big guns with dynamite. It also smashes to pieces other huge iron castings, to be sold to scrap dealers. The noise of the explosions can be heard for miles. On July 6 the company received two historic cannon, which will be broken into pieces. They were brought from the Brooklyn Navy Yard on special cars and they weigh 90,470 and 95,625 pounds. The guns were used at the Vicksburg siege by Gen. Grant's forces, firing shots of 1,200 pounds. The government officials were loath to have the guns destroyed and offered them to a number of Grand Army posts, but the necessary arrangements could not be made to have them accepted. In a few days these historic field pieces will be smashed into bits and sold for scrap. The company has broken up many defective cannon bought at gun works. It also smashes nearly all the condemned guns for the war and navy departments. The dynamite is fired by electricity and a few men do the work.

PRIMITIVE TRANSPORTATION.*

In judging the degrees or grades of culture which have characterized the different peoples of the world, the first thing to search out is some kind of a yardstick—some kind of a modulus by which those peoples can be gaged and measured. Are Philadelphians at the bottom in the industrial scale, or are they at the top or in the middle? Where are you going to place Philadelphia in the culture scale?

Lewis H. Morgan, of New York, gives in his book on

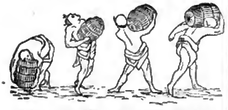


FIG. 1.—JAPANESE MAN SHOULDERING A PACKAGE OF RICE.

Ancient Society a set of gages for social measurement, viz., three grades of savagery, three of barbarism and three of civilization—nine grades altogether, based on social organization and industries. But one of the best measures of civilization is the acquisition and domestication of power for mechanical purposes.

Some tribes of men have no power under their control excepting that of the human body. Whatever they do, they do with their hands; whenever they go, they go with their feet.

In the next grade, man avails himself of the animals—the llama or others—that have become sub-

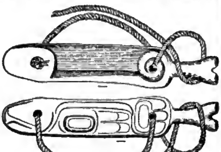


FIG. 2.—TREE-CLIMBING DEVICE OF TLINGIT INDIANS, SOUTHEASTERN ALASKA.

servient to his will, constituting beast power. Whatever be the agent—the dog, the hine, the llama, the camel, the elephant, the horse, the ass, the goat, the sheep—domesticated to come under human control, you have there an additional power added to the activities of a people. They feel the wind blowing upon their faces, see the trees bending before the gale, and the first thing you know some woman has made a mat out of grass and put it on the oar or paddle, forming mast and sail, and behold! the boat goes along through the water propelled by the wind. Or water itself may be used as a power, water floating or drifting articles

FIG. 3.—YOKAIA WOMAN CARRYING CHILD.

down stream or turning rude wheels. Man power, beast power, wind power, water power! Then add the power of fire—gross fire, fire that is more open and easy of access; after that the more refined uses of fire in steam, chemistry, electricity and light. As a result we have a series of domestications by which the peoples of the earth have conquered, one after another, these various forces of nature in order to their utilization as servants.

Looking backward, imagine a group of human beings walking upon the earth without clothing, without homes, but more particularly, without any skill. Of course they had shelter. If they wanted to go under something or into something for the purpose of keeping themselves from the rain, or the snow, or the

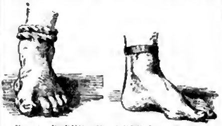


FIG. 4.—PERUVIAN ANKLE BANDS FOR TRAVELERS.

storm, or the wild beast, they had some refuge like the foxes or the moles; but they had no skill.

Mark well that epoch, that particular condition of humanity in which it was without skill; for it seems to me that the true destiny of our species is the artificial one in which we escape from the natural life and the natural proclivities and inexperiences into something that is artificial. When we multiply our wants for the sake of multiplying them, and multiply the means of gratification for the sake of multiplying our wants, we are in the stream of progress.

"Those poor wretches" (as Shakespeare calls them) "on the edge of time" had no skill, and from the skillless man of primitive time to the skillful man of Philadelphia is a long journey in many ways, in which the milestones are carrying devices, sails, windmills, engines and machines of infinite variety.

Now there are five sets of industries in which this skill in dominating power is manifested, going on from nothing to something, from absolute ignorance of things and from a want of experience in all respects to perfect knowledge, namely, exploitation, manufacture, transportation, commerce and exchange, and consumption or enjoyment.

First of all, Nature was endowed before the human period with materials that were destined to be useful to this coming race. The bounty of Mother Nature is so great that before there was a human being on the face of the earth there seemed to have been provided everything that man was going to need, if he would only look for it and find it, with this one exception; while the eagle had wings with which it could soar aloft, and the fish had fins by which it could swim, and the lion had fangs for tearing its food, and the mole

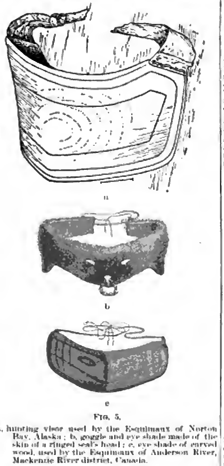


FIG. 5.

a, hunting visor used by the Esquimaux of Norton Bay, Alaska; b, goggle and eye shade made of the skin of a ringed seal's head; c, eye shade of carved wood, used by the Esquimaux of Anderson River, Mackenzie River district, Canada.

had the apparatus by which it could go underground, and each species, each family, each part of the animal creation was provided in itself, on itself, as a part of itself, with those tools and apparatuses that were going to be useful in the development of the life of those creatures, the finger nails of man will not compare with the toes of the bear; these little teeth I have in my mouth bear no comparison whatever to the teeth of the chimpanzee, or the tiger, or the lion; I have no wings with which to fly; I cannot go down into the sea very deeply, and cannot burrow in the earth like the mole. It seems to me if the animals had gathered around this weakling when first he made his appear-

FIG. 7.—THE PRIMITIVE UMBRELLA IN GUATEMALA.

ance on the earth, they would have said, "He is a poor naked wretch, indeed, and I don't believe he will stay here very long. How can he scratch for a living? how can he bite? how can he swim? He has no hair on his body; he will freeze; the hot sun will burn him up; he has no teeth by which he can grind coarse food; all of the apparatus of life seem to be so wanting in his nature; what is he going to do?" He lacked everything excepting that fertile provision of brain enlarged at the expense of bodily organs by which his thought could by and by be evoked. If he cannot bite like the lion, he can go to the volcano and there draw out the

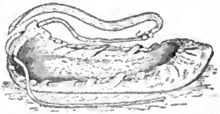


FIG. 8.—RAWHIDE SANDAL, WITH PUCKERED MARGIN, PACHACAMAC, PERU.

fire and learn how to create that fire himself so as to have in his hands a tooth that can bite sharper than that of the lion. He builds a little fire around his tent or his camping place and no lion dare go near him. The fang of the lion is very fatal, but the firebrand is more fatal. He cannot now fly into the air like the eagle, which can go only half a mile or so; but anon, you will see him soaring five, six, seven miles up into the air. The fish does not swim more than about a thousand feet down into the sea, but here comes along a creature who cannot at first even dive there; but by and by you can see him going down into the profoundest depths, and he will send machinery still further to investigate the bottom. Though he cannot

FIG. 9.—MAN'S ORNAMENTAL BOOT USED BY THE ESQUIMAUX OF POINT BARROW, ALASKA.

burrow into the ground like the mole, he will dig down one, two and three miles in the earth, bringing up the coal and iron, the gold and silver. There is nothing that any creature can do that he will not do by and by better.

Kind Nature has provided in the air, and the water and the earth the means of evoking this wonderful spirit of man; and the five sorts of industries of which I was about to speak would be, first of all, going to

* Lecture delivered at the Academy of Natural Sciences, Philadelphia, Pa., by Prof. Otis T. Mason, of the Smithsonian Institution, Washington, D. C. Revised by the author. The illustrations are from Prof. Mason's monograph "Primitive Travel and Transportation" in the Report of the United States National Museum, 1894, and are loaned by the Smithsonian Institution, cuts 8 and 10 by the Bureau of Ethnology.

Nature for her gifts, to dig up something to eat, to move into the waters or under the waters and there find something to eat, to go into the forest or field and there find something ready to eat—only simply helping himself from the bounties of Nature. Furthermore, as he will some day want to make his clothing, mats, etc., of textiles, there was plenty of textile material at hand and raw stuff for all industries.

Now, it is a curious fact that, if you look at this first

FIG. 10.—ESQUIMAU DOG HARNESSED FOR SLED.

man, this first group of human beings, these beings worthy to be called men, you will find that they are doomed to be always dissatisfied, to be driven out. Inasmuch as they have to develop themselves from within, and not on account of, or by means of, any accessories they have on the outside of them. They have to be always and everywhere dissatisfied, first of all that nothing is in the shape in which it is to be wanted.

It is said that the monkeys will take a stone and with it crack a cocoanut. The human creature is not constructed to crack a cocoanut in that way. He is first to be dissatisfied with the stone as a hammer, and to break off a piece and make some modification in the form and so become a tool maker. Whatever is, is wrong with him; that is his philosophy. It has the wrong form; he must change the form of it. As his species grows older and more skilled, he breaks the stone more and more. At last he grinds it to meal and to flour, and, last of all, he fashions therefrom his Dresden pottery, but is never satisfied with the forms of things. All the great manufactures of the world were evolutionized by this dissatisfied spirit in man.

Again, nothing is where it ought to be, even in the

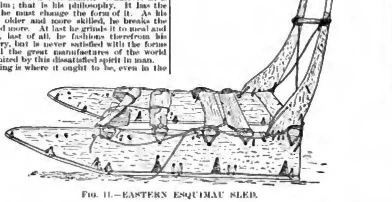


FIG. 11.—EASTERN ESQUIMAU SLED.

minds of little children. Most of the animals think that things are where they ought to be; they change the place little. But this creature that is going to dominate the earth is to be terribly dissatisfied with the places of things.

A third dissatisfaction is in the ownership of things. If there is one of these men living down on the sea that has been eating fish, and another on the hill eating nuts, the first thing you know is they are carrying their respective products one to the other for a change of diet. This swopping will lay the foundation of a whole series of industries. Forms of enjoyment are

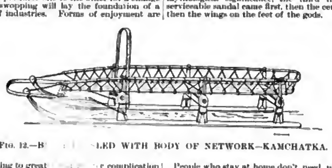


FIG. 12.—B[illegible]LED WITH BODY OF NETWORK—KAMCHATKA.

also ever changing to great[illegible]e complication of industry.

Therefore we have, first, g[illegible]fts of Nature; second, changing their for[illegible]tures; third, changing their place, or tra[illegible]and then the exchange or barter, followed[illegible]nt, consumption, using things up in their[illegible]e, constituting the fifth group.

Travel and transportation h[illegible]t forms are illustrated in your electric e[illegible]s, railway trains, chemical motors, heat[illegible]tromotors, photomotors. It was not alway[illegible] The first traveler was a barefooted human being: the first common carrier was a woman, and she had very little apparatus to do with. The first passenger car was the body, a woman carrying a child! Not a naked body carrying a naked child: apes do that. That is not where artificial carrying begins; not as the sparrow picks up a straw from the ground and flies away with it in its beak to make a nest. With that primitive man or woman who first thought of a device to carry something with, originated the beginning of transportation, the beginning of artificial travel, of artistic travel, of human travel, at that time when some sort of an instrument was invented, or used, or picked up by means of which something else was to be carried.

Much has been written of the hand, the brain and other parts of the body; but lecturers will some day discuss the human foot as a carrying apparatus. The human back, the human shoulders, the human head, the human arms, the human hand and all parts of the body, physiologically and anatomically considered, are carrying apparatus; and man is a carrying animal.

How much has the carrying trade to do with human costume? Anthropologists say dress was originally some sort of mythological or artistic ornamentation of the body, wherein the idea of clothing was an afterthought. From our point of view, dress is the first thought; its artistic form, the secondary thought; its mythological significance, the third thought. The serviceable sandal came first, then the ceremonial shoe, then the wings on the feet of the gods.

People who stay at home don't need much costume. In the Esquimau hut you will find men and women without clothing; but they never walk on foot outside in that state. The first step they take abroad they must be clad warmly. In the sunny tropics people may exist without costume, without clothing if they live in the shade; but the moment they expose themselves to the heat they have also to invent some sort of costume. Just as a house everywhere shields the family — father, mother and children — against the storm, against the sun, against the wind, against the wild beasts, so against these four factors must any costume provide that man may don to go abroad, out from under the shadow and shield of his house, in order to travel or to carry.

The first invention differentiating the travelling man is some kind of out of door costume. What is a hat? A hat is a roof—an individual roof—a covering for the head. I must have such a roof as will not cover up my face. I must see, must hear, must smell, must put all my senses at work, so that this part of my body by

FIG. 13.—PAPAGO WOMAN WITH KIBO PROPERLY MOUNTED.

which I look out upon the external world will be most exposed. If it is to be a sunny exposure, I will make an umbrella hat; if in a cold country, a fur hat; if in a snowbound land, a visor hat. Perhaps I am to walk in a country where sometimes the temperature is 80° below zero; but being an ingenious creature, I am not going to be dismayed by any cold like that; so I will go to work and invent a covering equal to that climate. If, on the other hand, I am to live where the thermometer is 120°, if there is any danger of the sun blistering my head, I am perfectly equal to inventing an umbrella or palm leaf covering. We are not afraid of anything; we are endowed to be prepared for every emergency. So this whole matter of covering the head is one of balancing between the head and the outside world. Whatever may be the climate, whatever may be the environment, the little inventor will be equal to the occasion if necessary to modify or create environments. He says this hat is very hard to carry around when the sun goes down and I no longer need the protection. Can't I devise a hat that will take down? So the parasol or umbrella is invented—

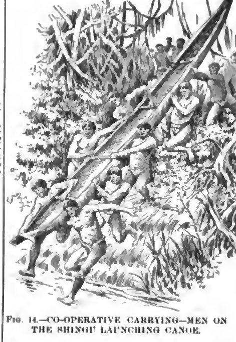


FIG. 14.—CO-OPERATIVE CARRYING—MEN ON THE SHINGU LAUNCHING CANOE.

merely a hat that will shut up—whose main cost is in preparing it to be carried. In the whole series of head coverings you have this little inventor making himself happy, as Emerson says, "in all climates and conditions," because he can cover his head.

The foot is the objective point of many traveling devices. What is the objection to going everywhere barefooted? Down in Baltimore there is a society that wander about in Druid Hill Park early in the morning, barefooted. They are perfectly welcome to their enjoyment. Our race, for a good many thousand years, have

made themselves comfortable with shoes. The human race walked over this whole earth. Before there was a beast of burden or anything tamed on which to ride, mankind had covered this whole earth. They must go on now to the end; the only problem is to be comfortable in the going. The first need was merely something to protect the foot from the ground, from wounding or the wearing out. This every one who has gone barefooted knows. You will stub your toes, or if you move into a cactus country you cannot go barefooted at all, or if into a tropical country there are many reasons why you must have something between your foot and the ground.

But, the moment you begin to travel or to carry, you are bound to look after your feet, and the sandal is the first effort to protect the foot of the traveling man from abrasions and the dangers that beset his way. No

FIG. 15.—APACHE SQUAW CARRYING CHILD.

wonder that in Grecian mythology they have Hermes with wings upon his feet. These wings are his sandals. The one invention that differentiated the traveling man from the stay-at-home was the sandal. Should any of you come to Washington, I can show you a very interesting collection of these. I have been trying to gather a sandal from every people on the face of the earth that wear sandals. Now, it is an interesting fact that in many of the inventions that have an imaginative motive behind them there is a great deal of differentiation of personal equation. If you, for example, should look at a collection of Moqui pottery, when you get the practical diameter of those vessels of a certain class, they are all between 8 and 9 inches in width; but when you read the symbols on these pots, out of 2,000 there will no two be decorated alike; when the potter came into the realm of fancy, of mythology, the individual mind just bloomed out into variation; likewise in the useful footgear there is a similarity that gives to the sandal a character of differentiation that is scientific. So when I examine the sandal of a Japanese and afterward look at another that is just like it, I say that is Japanese. No one ever saw a Chinaman wearing sandals. All the Japanese working sandals have

FIG. 16.—ESQUIMAU WOMAN OF POINT BARROW CARRYING CHILD.

the same characteristics; and these people in their daily life, in their daily arts, in their daily toil, have been brought, in some way or other, to use a certain type of shoe which characterizes their race and affiliations everywhere.

Suppose we have men on the Congo River. What do they do there? They carry, carry, carry, carry—on their heads, on their backs; year in and year out they have been going that way from the Congo down to the Gold Coast; streams of slaves going to-day just the same, and their feet are shod with shoes exactly adapted to the climate in which they are moving—just a little bunch of straw under their feet, to make a cool pad between them and the ground.

Under other conditions another kind of shoe will prevail. As you go north it is interesting to see how the sides of the sandal have been moving up over the feet—frosty nights making it necessary to get a little more covering. If you were to walk through Egypt into Palestine, into Turkestan, you would gradually convert your sandal into a shoe, and in the Siberian country into a closely made boot—the foot protected not only against abrasion from without but against the extremes of cold.

Whatever occasion may arise, you will find that as perfect music unto perfect words is this fitting or adapting of the thing used to its uses; this harmonizing of the man with his environment or surroundings goes on everywhere. Now here is a construction to be worn by a man who lives, I will say, in Alaska. It is of sealskin which has been sweated and the hair pulled out so as not to remove the thin, black cuticle. The sole has been sweated a little and the hair has been cut off carefully, leaving every bit of the cuticle. Why? Because it is a summer boot, to be worn when the snow is melting, and the foot is not only to be protected from the cold, but from the wet. That is an Esquimau waterproof boot—the upper leather tanned in the usual way. For walking over melted snow there is nothing better than that. The edge of the sole has been carried up and split; the upper leather brought down, and the seams sewed together in such a way that no water can enter.

Going around in winter the Esquimaux would have on

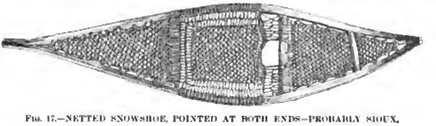


FIG. 17.—NETTED SNOWSHOE, POINTED AT BOTH ENDS—PROBABLY SIOUX.

a very different kind of a boot; but it would be exactly adapted to the conditions under which it was to be used. The same genius shown in our day in constructing electric engines is shown by these people in overcoming the difficulties which confront them. Snowshoes also form a very interesting study in this line of invention. These must have come from far North, where the snow is hard. Since the netting is coarse, the snow must have been so packed that the hunter walked on quite solid ice. In fact, the coarsest lacing either comes from the Chukchi country in northeastern Asia, or from Alaska somewhere near Behring Strait; but as you go southward you have the same story told of harmony between the ingenious mind of the individual, the inherited or tribal idiosyncrasy and the ever varying environment. The Canadian snowshoe is identified by the fineness of the mesh and the net filament. As you go farther south the snow is more liable to push up through the meshes like plastering through laths, and ball up on the snowshoe. The meshes must become smaller and smaller in order to fit them to the quality of the snow. When you reach the northern boundary of the United States, the function of the snowshoe is ended. But impelled by the irresistible spirit of progress men had to puzzle their inventive brains to improve on mere foot travel. They went to live, we will say, at some time or other, in a region surrounded by wolves—rather near to them at times—only that men had invented fire and could kindle a little circle of fire around them, outside of which the wolves howl and yelp. In the daytime these people went out of their villages and hunted the deer and the bear for food. The women cut the hides off on the outskirts of that little village, and stripped the meat from the bones. The wolves came nearer in order that they might gnaw these bones; and so a kind of treaty, or flag of truce, is sent in by the wolves. They say, "We will bark at night when there is any enemy around, and you will let us pick these bones in peace." If a mountain lion approached, these village wild beasts set up their yelping and barking, the men going out armed in order to defend themselves. If a herd of deer approached, the wolves gave notice also. Later the wolves became the scavengers of the village and the children began to tame them and lay burdens on their backs; and the men said, "You may help me carry this load;" and so the wolf becomes the domesticated dog—first a wild savage, comparative enemy, then a mutually respecting society, then a mutual admiration society; then a mutual co-operation society; and by and by comes along the period of individual ownership, and these wild, savage, bloodthirsty wolves become our domestic dogs—works of art; and we breed them just for the amusement of it.

So with the horse. He begins to find that man is more near to him than an enemy. He is hunted for food, but by and by it is found out his back is worth more than his meat; and so he is domesticated. So with the sheep and the reindeer and the camel. They have come and said, "Here we are. We will enlist in your regiment and in your service."

Animal power is now harnessed up for the use of man. Notice this, however, that in addition to the enslavement of animals, men continued to be burden bearers. The more that animals were domesticated, the more work men had to do; because their wants increased. Men toiled harder when the dog and reindeer and horse came into their service than before. The more power we get into our hands, the harder we work. I do not believe any savages that ever lived worked so hard as does a stoker in one of your comfortable steamships or a roustabout on your wharves. The more we harness up these powers—the more they are brought under our sway—the harder we have to work to enjoy them; and so it has gone on.

Now as to the use of appliances—of harness—in this work of transportation. The African in Southern Africa has a splendid head of hair, and they are not going to muss that elegant covering in carrying. So they do their transportation on their backs in great frames. The Esquimau does not carry heavy loads at all. They have a most excellent substitute for their backs in sledges or sleds. The snow is Nature's track. Long before there were any steel rails, Nature had laid all along the hyperborean region the most delightful track in the world; and these sledges placed upon these tracks go along so easily that a man can drag four times as much as he can carry on his back. The Esquimau is capable of lifting heavy loads, but he does not carry them long distances.

Coming a little further south, we find the Chilcat man—his coast is very short, his mountain very long; and across the mountains are the great Athapascan people and the mountain people who have the things that he wants; so he has to harness himself up in a way to make carrying easy. His plan is to take a strap or piece of leather and make a bandage, resting it across the forehead and putting the load upon his back. All the muscles of the head and neck are involved—part of the load resting on the shoulders, and on the back between the shoulders and on the hips; so that every carrying muscle, every part of that man's body that is capable of carrying, is involved in the operation.

Carrying with the head band and basket on the back is an American habit. It existed among the northern tribes from the earliest information we have, all down the California coast. To-day the women who do the carrying (they are the beasts of burden always and everywhere) have baskets which fit upon their backs and shoulders, and head bands across the foreheads. Mexico is the greatest land in America, and perhaps in the world, for carrying with the head band. You cannot get a photograph of anything in Mexico but some old fellow has a great big jar of water on his back; or there is a peon coming to town with a basket of meat on the back of his head, or swung from his forehead, perhaps, 200 pounds of meat—bringing them in over the hills, or over the rough passes of the mountains, competing with the railroads and underbidding them, because they have such short journeys.

Still further, in South America, you see woven into their tapestries and everywhere across the mountain sides the people with bands across the foreheads and a load upon the back. The Pueblo Indians may have possessed the head ring for toting, but the great carrying business of this continent was done on the back, with the band passing over the forehead.

In Africa, away from the Bantu country, the real negroes—the negroes of the Soudan—carry loads on their heads. Dr. Brinton's "Nations and Peoples" discusses this question among the Hamitic people of Northern Africa, but all negroes practice it as well. Carrying on the head has also prevailed all through southeastern Asia, in Phenicia, over across into the Mesopotamian Valley; in the Philippines. Down among the peoples of Polynesia toting is a very common practice, with or without harness.

When the load was transferred from the back or head of the man to the beast, of course the harness must be modified; but the main structure of the harness or strap of the man was simply taken from his body and put upon the body of the beast.

NAVIGATION OR WATER TRANSPORTATION.

Another very important link in this chain is that of navigation or traveling on the water. It is easy enough

FIG. 18.—WOMAN OF BRITTANY CARRYING CHILD.

for a man to get on a log or a bladder and float across a stream. These might not be called navigation devices at all. Navigation, or traveling and transportation on the water, as also land locomotion, would begin with some kind of an artificial device which would differentiate the boat or the ship from the mere flotation. Mere flotation, perhaps, is not navigation; yet the earliest forms of travel by water were simple flotation; but the apparatus is a manufactured one.

Going up the Mississippi or Missouri River thirty years ago you would have seen an Indian woman stretching a buffalo hide over a frame to make a very ugly looking tub. Into this tub she got with her luggage and crossed the Missouri River. In order that this craft might be steadied in its course and brought across the river, she had to invent some sort of steering gear.

The differentiation of navigation from mere floating took its rise in the invention of the keel. The simplest forms of primitive boats exhibit some effort to guide the vessel on its course, in the direction in which it does not want to go. If it tends to go this way, the human quality is to make it go that way; if the wind blows it east, the human quality compels it to go south or west. This boat is to be modified to go away from the course in which nature would take it into some other course according to the human will. This is the perfection, say, of an Esquimau woman's boat, in which the skin is drawn over a frame and the woman stands along the side and paddles it in still water.

But the man's boat, in which he is not to be afraid of any danger, in which he rights himself if capsized; puts himself down into it through a little hatch; covers himself with a waterproof jacket lashed at the bottom or lower hem around the combing; and so tightens his craft that no water can get in there, in which he faces the sea, goes out to hunt the walrus and the seal, furnishing really a first attempt to guide a craft and make a seaworthy boat. The most successful people in the world for navigation of this primitive sort are the Polynesians, who discovered every island in the Pacific Ocean 400 years before Columbus—without compass or guide of any mechanical sort, and in open boats. But they had invented three requisites to voyaging: first, to manufacture dry food—to dig a native root and grind and condense it in such a way that they could carry subsistence for a long journey; secondly they had invented a shifting sail. These poor fellows had indeed no tackle; but whenever they wished to bring the boat on the wind or off the wind they had to climb up to the masthead, untie the sail, bring it down, turn it around and put it on the other side of the mast and then sail other end first, making one end of the boat now the stern and then the bow, so that they could tack back and forth in a wind. The third epoch-making device was the outrigger. The Polynesian boat is sharp, like a very thin canoe. Across the top are timbers to which an outrigger is lashed, so that when the wind is leaning her over in one direction the sailors can climb out upon this outrigger and right her. With that craft and its outrigger and poorly shifting sails, in that little device, with their dried root and their perfectly fearless manner in the sea, the Samoans and Tongans managed to cover every archipelago in the Pacific Ocean. They went all the way from the Society Islands to the Sandwich Islands; from the Society Islands to the Easter Islands and to New Zealand; and from the Society Islands to Madagascar. From this point to the Easter Islands is over 3,000 miles.

TRANSPORTATION OF PASSENGERS—THE PASSENGER TRADE.

The first attempt to transport a human being was made by a woman in carrying her baby around in some sort of device.

In the tropics the baby does not ride in the cradle, but crawls around on the mother's back, aided by a meager girdle. How it sticks there I do not know; but whenever you examine an African picture or South American picture of native life, you will see babies crawling around on the bodies of their mothers, very little clothing on the bodies of either, and yet the youngling manages to stick there. As you go northward the little thing begins to find a refuge somewhere.

As you go farther north and the climate is colder—the temperature difference between the body of the child and the outside increases—the little fellow is gotten into some sort of a frame. In northern Mexico it is a hurdle, with a fringe or covering of deer skin; and in the cold of early morning or late in the evening this is simply thrown over the body of the child. And when the day grows warmer this curtain is thrown down. A little farther north and you will find the frame to be a trough, made of cedar; and the little one is laid in it and covered with the cedar bark. And still further north, the bed is made of fur or rabbit skins, and a little deeper it lies in this shroud or covering and it is still further protected from the climate. There is a regular harmony in this gradation. When you get to Mount St. Elias, no more cradles—too cold. The mother has a great big bonnet on her head, as large as a half bushel. The baby rests in this hood, just like the mouse in its nest; so that the carrying of a child from the tropical parts northward to the Arctic region is a tune—a kind of harmonic arrangement between the tender sympathy and care of that mother and her little helpless baby, whose life is so dear to her, and the meteorological conditions of nature.

When you cross Behring Sea into Asia you come to the same cradle you had in British Columbia—it is a wooden dugout. It can be carried on the mother's back and the child covered in and perfectly protected. But when the natives take to riding on the reindeer, or on the plains of our country begin to ride horses, and there is danger in the carrying of the child that, if it falls off it will be injured, you will find another arrangement. The Sioux Indian cradle is after this fashion, and, among all those Indian tribes where the child is exposed to injuries from falling or from wounds, there is seen a mother's provision of something to protect against the danger. The invention is always equal to the emergency. All through northern Siberia that kind of cradle is used.

The carrying of passengers on human backs becomes, in the next cultured grade above, riding on beasts. At one place they make the reindeer the "saddle horse;" in another place, the elephant; in another place, the elk; in another place, the cow, but the first beast riding is on the animal's back, with a saddle; in the next, the creature drags man over the snow in a sled or hauls him in a wheel vehicle. In Alaska, Arctic Canada and Greenland the sled is an excellent invention for the study of ethnic peculiarities co-operating with diversified surroundings. Examples from northeast Asia were brought by the Russians, who came into Alaska that way.

The north of Greenland sled is, in comparison, a poverty stricken patchwork of wreckage, held together with rawhide thongs.

The animal that draws the sled is, in every case, throughout the western world, the dog.

The origin of the wheel is a mystery, but it never could have originated in any other than a flat country. There are no roads in nature. The first roads were paths of animals, called trails; then men walked in those trails and they became paths, and after awhile became human roads, along which beasts of burden came. By and by, perhaps through some sort of a drill of these animals, in which they required more road space, the road became wider; but certainly the wheel did not originate in a hilly country. It originated in northern or western Asia, where there is a vast plain, and where all nature is one great road. To trace the four-wheel carriage of moderns through all its phases, from the original one wheel, is a long story—but it has developed in historic times.

Along this early track we travel in order that we may find the first fruits of that thinking, devising, inventing, which lie at the foundation of the most wonderful spectacle that we see to-day. We never sit down to a meal that we are not partaking of the labors of the whole earth. Our breakfasts, our dinners, our suppers, our dress that we wear, our furniture that we use—the blessings that we enjoy every day—are gathered in from the four corners of the earth, as though we could shut our eyes and hear the tramp of human feet and domesticated beasts for thousands of years over the earth, preparing the way for these great modern industries that we call transportation.

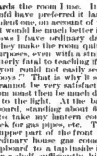
PHOTOGRAPHY AND GEOGRAPHY.

By A. E. MURRAY.

As the lantern and photography are hobbies of mine, I have much pleasure in communicating a few notes as to teaching geography by means of photography and the lime light.

First, as regards the room I use. It is about 15 feet square. I should have preferred it larger, but it was the only convenient one, on account of the windows. It faces south, but would be much better if it faced north. Over the windows I have ordinary dark green roller blinds; I find they make the room quite dark enough for teaching purposes, even with a strong sun shining. It would be utterly fatal to teaching if the room were so dark that you could not easily see your class, for "boys will be boys!" That is why it seems to me that an oil lantern cannot be very satisfactory for the purpose, as the room must then be much darker.

Secondly, as to the light. At the back of the room I have a cupboard, standing about 6 feet high, just wide enough to take my lantern comfortably, with space at the back for gas pipes, etc. The whole of one side and the upper part of the front are doors. The pipe for the ordinary house gas comes down at the back of the cupboard to a tap inside it. The lantern itself stands on a shelf, sufficiently high to clear the boys' heads. Below at the back, but inside the cupboard,



W, window; D, door; C, lantern cupboard; F, forms, S, sheet; T, teacher.

stands a box containing a 40 foot cylinder of oxygen gas. The rest of the space beneath the lantern is fitted with shelves to hold the boxes of slides, etc.

A word as to the lantern. I will not go into all its merits, for it might lead me to blow my trumpet too loudly. I will simply say that it was made for me after my own pattern. The only special point I must mention is the jet, for, after about 20 or 25 years' work with the lantern and after making several jets myself, I am convinced that for ordinary purposes, say for a disk 12 feet square, a great deal more oxygen is used than is necessary. My jet has so small an orifice that I only burn 1 foot of oxygen per hour. Also the arrangement of the nozzle of the blow-through jet is seldom, in my opinion, satisfactory. The lantern is kept always connected up with the gases, and, therefore, when the time for the class arrives, all that is necessary to be done is to put on a lime and turn the taps, and then everything is ready. In passing I may say that the cupboard is also most useful for enlarging, for, with the side door shut and the front door open for the nozzle of the lantern, it is almost dark enough; but with a piece of black twill lining fastened in front, with a round hole for the lens of the lantern, absolute darkness is obtained. A hole may be cut at the top of the cupboard to let out the heat. One more wrinkle before leaving the lantern. When I was inexperienced, if a lime broke I threw it away, but now one often lasts me for a week or more. A lime nearly always breaks in the center. Don't try to join the old breaks together if you want to use it again, but put the top and bottom ends together thus. You will find the crack will not affect the light at all, and the lime will have no tendency to break again. I far prefer the hard limes, even for

the blow-through jet, especially for semidaylight lantern work. The light is much whiter, and the hard lime withstands the dampness of the atmosphere longer. Often I leave a lime a day without putting it away, but my usual plan is to put it back into the brass tube the same night.

In front of the lantern I usually have three forms arranged as shown on the sketch. On the opposite side of the room there is a frame about eight feet square, on which a piece of white calico without a seam is stretched. Of course, if the lantern is tilted much, this ought to be slanted forward a little from the top. When teaching I usually stand about the spot, T, with a thin pointer in my hand; I need hardly say I point with the shadow, not the substance.

Now as regards the maps I use. Some I have bought, but I was so disgusted with many of those I purchased, that a year ago I determined to take up photography, chiefly for the purpose of map making and copying diagrams. Before coming to this determination I tried several of the best makers who profess to supply maps for the lantern. I will call the first firm Messrs. A. They photographed their slides from colored originals, hence some parts were very dark indeed; the maps were crowded with names. They were photographed at least twenty years ago, and the price colored I think was 3/6 each. Next came Messrs. B. Many of their maps were very good, but very expensive; I asked them to photograph one specially for me, and I supplied them with the original. When it came home it was so foggy I was ashamed to use it. A colored map I had from them is an utter disgrace to anybody, and when I complained they said it was quite true, they were very disappointed with the man who colored it, but now they had somebody far better! Another map, of Scotland (which took in a part of England), showed a large portion of Northumberland overflowed by the German Ocean. When I came to use the map for the first time I felt as much "at sea" as Northumberland must have felt. After these experiences I thought I would try Messrs. C. I wrote to them for several maps, including one of Palestine. It duly arrived, and on it all the towns, villages, etc., were duly recorded en masse, thus making it very unsuitable for a slide. I requested them to color it for me, but, alas! several of the divisions were completely miscolored! I have tried a local man, but, of course, I had to supply him with suitable maps, and I must say his photographs were as good as I could wish.

Now for my own work. Being only an infant of a year old, as may be imagined, I am not perfect yet in slide making, but I can turn out slides which are clear in the clear parts and of a good depth in the others. Personally, I like amidol best for maps; it develops very rapidly and does not seem to give the other part time to fog. Out and out the best maps I know for photography are the series published in "Outlines of Geography," by Somerville & Thompson (Percival & Company). The paper is very white and the outlines thick and black, only the important places and features are inserted. The maps themselves, here and there, are not over-correct, e. g., in the map of Europe the Apennines have disappeared from Italy, and in the map of England, Bardsey Island from off Wales, but these are trifles. Unfortunately there is no map of England divided into counties, but instead what I think almost useless, one crowded with railways. I should like to come across a series of physical maps equally suitable. To teach geography properly, there ought to be at least three maps of each country—physical, political and blank. Besides maps of countries, I also use maps showing the winds, ocean currents, etc., and I hope by and by to add geological maps. I have found it most useful to photograph the diagrams as to map making, the bed of the Atlantic, etc., given in Grove's small geography, which is the textbook for the entrance examination for the Britannia—in fact I photograph (when time permits) any picture I think suitable for the purpose, e. g., a bird's eye view of the Crimea, to illustrate a peninsula and an isthmus. But I do not confine myself to maps and diagrams. Since teaching geography by the lantern, I have been accumulating slides of different places of interest, for example, Niagara Falls, Giant's Causeway, etc., and at the end of a lesson, if the class has been attentive, I reward it by throwing on the screen two or three slides bearing, if possible, on the subject we have been taking. I consider that the results are most satisfactory, as the teacher can teach far better and the boys themselves like the plan, and I am certain they take more interest than in the ordinary way. It is also a very great advantage being able to change from one map to another so easily. The cost is decidedly not great, if you take into consideration the amount you have to pay for large school maps, and the trouble is very trifling if you have everything properly arranged and at your fingers' ends.

There is another way in which I have pressed photography into the service of geography. At the end of a term I usually want boys to fill in a map of which I give them the outline; I could not keep at hand hundreds of outlines of the different countries, so I prepare the outlines as follows: Using the lantern cupboard and the original negative, I make an enlargement on bromide paper just large enough to be copied in the cyclostyle, quarto size; I lay this enlargement on the usual thin paper of the cyclostyle and go over any lines I want to copy with a lead pencil. This makes a distinct whitish line on the cyclostyle paper. I go over this outline with the cyclostyle pen and then print off as many copies as I require. This term I used Africa, South America and Australia, prepared in this way. The enlargement will last practically for ever. No one who has not tried the plan can imagine how easy it is.

I see I have omitted all mention of coloring. Unfortunately, I cannot get time to color many of the slides, but undoubtedly it is better to do so. I have colored several in outline and find it quite sufficient. I do not think any amateur could color the whole surface of a map satisfactorily without great practice. Lastly, I may mention, although not connected with photography, that I sometimes make simple diagrams on a glass cut the size of a lantern slide, and covered with a dark orange preparation. Those I used came from Newcastle. The diagram is drawn in pencil and then gone over with the point of a needle; this produces very effective slides, the lines being bright on a dark background.—Practical Photographer.

JAPAN AND THE UNITED STATES TARIFF.

IT is quite evident that Japan means to make her influence felt in the world whenever and wherever she legitimately can. Some time ago she let the United States of America know that she had interests in Hawaii which are not to be lightly put aside, and, indeed, wherever Japan's interests are affected, there she has agents who intelligently and clearly do all in their power to safeguard them.

The United States tariff has lately been receiving the

great attention of the Japanese Chamber of Commerce, and memorials and representations have been made to the United States government and to the American Chamber of Commerce, pointing out the disastrous effects which the proposed tariff would have on the trade between the two countries. These representations do not seem to have had much effect, as the tariff bill has passed with a few modifications; still, as indicating the opinions of intelligent and influential Japanese on the question, it will be interesting to note the action which has been taken in the matter by the Yokohama and Tokyo Japanese Chamber of Commerce. The chairman of the Tokyo Chamber of Commerce telegraphed to the chairman of the United States Senate Committee on Foreign Relations, to the effect that if the tariff bill were carried out, it would ruin the trade between the United States and Japan, and, therefore, the Tokyo Chamber of Commerce requested the committee to give the matter its most serious consideration. The Yokohama Chamber of Commerce, in its memorial, pointed out that the United States of America occupied not only a most prominent position among the countries with which Japan was commercially connected, but also that it had close relations with Japan in other respects. The recent expansion of the Japanese maritime service had so considerably increased the facilities of communication between the two countries that the opportunity presented itself for the furtherance of mutual commerce. Under these circumstances it was absolutely indispensable that both nations should take such steps as were calculated to enlarge their commercial relations, to consolidate their friendly feelings toward each other and to promote mutual interests. If the proposed tariff were put into effect, it would have a disastrous effect on the trade, and be sure to impair the commercial peace existing between the two countries. The comparatively high taxes contemplated by the new tariff are to be imposed upon silk manufactures, tea, carpets, fancy matting, and earthen and porcelain wares, all of which constitute staple articles of production in Japan. The memorial admitted that the trade between Japan and the United States in past years had been rather one sided. The United States had proved excellent customers for Japanese raw silk, silk manufactures, tea, etc., while Japan had only bought kerosene oil, flour and a few other commodities. But recently there had been wider developments, and locomotives and machines, cotton, velvets, hardware and many other articles formerly imported from various countries of Europe had recently been purchased from America. Thus commerce with America had been advancing in proper sequence of progress, with every prospect of a brighter future, and it never entered the imagination of Japanese business men that such a tariff would be presented to a legislature which, to a certain extent, had always exhibited toward Japan a warm sentiment of sympathy. The memorial from the Tokyo Chamber of Commerce was in very similar terms. Indeed, it went so far as to say that the proposed tariff could not but give rise to a suspicion that the object of the projected tariff revision was especially to prohibit the importation of Japanese manufactured goods. Bearing in mind that Japan had always felt a lively gratitude for the good will shown by America, the memorialists were at a loss to perceive what had induced her to take this sudden action. While admitting that the balance of trade had always been against America, the memorialists said that so great has been the Japanese desire to show their good will to that country, that they had sincerely endeavored to maintain a balance of trade between the two countries by giving large orders for rails and warships. This is a confession which ought to be noted by British steel manufacturers and shipbuilders. The memorialists stated that when they found, notwithstanding these expressions of good will on the part of Japan, that America actually proposed to prohibit the importation of Japanese manufactured goods, the whole nation could not but be astonished at such unexpected action, which would not only seriously injure their national feelings, but also be prejudicial to the trade between the two countries.—London Engineering.

THE GLOW WORM AND THE X RAYS.

Several Coleoptera of the tribe Lampyridæ possess the property of emitting light, but the name of glow worm is reserved especially for one of the most widely distributed species, the Lampyris noctiluca (Fig. 1). This is an insect belonging to the order Coleoptera, tribe Malacoderma, and family Lampyrids. The light of the male is scarcely visible. It is the female only that, properly speaking, is the glow worm. The larvæ also are called by this name, but they are always less luminous than the females. The photogenic apparatus (Fig. 2) occupies the underside of the three last rings of the abdomen in the female, and of the two last in the male, in which it is but slightly developed. The larvæ, which are alike in both sexes, feed especially upon terrestial mollusks. They pass the winter in a torpid state. At the moment of pupation, their skin splits upon the sides of the thorax, and not upon the back, as happens with other Coleoptera.

The chrysalis of the male is immovable, as in all the insects of this order, but by a singular exception that of the female is agile and phosphorescent like the larva and the adult (or perfect) female. The eggs likewise are phosphorescent. The adults begin to make their appearance at the end of May. The phosphorescence lasts for two or three days after death (to a slight degree), and Macaire (Annales de Physique et de Chimie) has shown that it may be rendered sensible by heating the insect.

This magic gift has long rendered this insect as celebrated among children as in the world of naturalists.

Without going back to Pliny or to the encyclopedists of the middle ages, several scientists of our century have studied its curious luminosity; and among others, Macartney (1810) and Matteucci (1846), who have thrown much light upon certain points. In 1880, the question was taken up by M. Jousset. According to his researches, the granular protoplasmic cells produce a substance that becomes luminous in contact with the air introduced by the tracheæ, and the phosphorescence of the lampyris is a general property of the protoplasm, proceeding from a disengagement of phosphureted hydrogen.

These conclusions do not seem to accord with the researches recently made by Prof. Muraoka, of the University of Kioto. Let us give these latter a moment of our attention. M. Becquerel, having found that certain fluorescent substances, such as the salts of uranium, emit rays analogous to those of Roentgen, the Japanese physicist conceived the idea of examining, from this view point, the light of the lampyris; and following are the principal results obtained in the course of his investigations, an account of which is given in the Annalen der Physick und Chemie.

In a preliminary experiment, this scientist placed thin plates of copper, aluminum and brass alongside of each other upon a photographic plate. In order to prevent a contact of the plate with the metals, he interposed a sheet of cardboard provided with a circular

Fig. 1.—GLOW WORM.

aperture in the centre. The whole, placed upon the bottom of a flat box, was covered with several thicknesses of black paper. He placed upon this about three hundred glow worms, which, along about the middle of June, are met with in abundance in the environs of Kioto, and hunting for which is one of the favorite pastimes of the gentle sex in the empire of the Mikado (Fig. 3). A net prevented them from flying away during the two days in which they were held as prisoners, and the apparatus was arranged in a dark room, to prevent the effect of extraneous light.

The question was to ascertain whether the rays emitted by the worms and filtered by the paper were capable of passing through the metals, and then of acting upon a photographic plate. The circular apertures formed in the sheets of cardboard permitted of the estimation, by comparison, of the intensity of the action. It was remarked that the parts of the plate in contact with the sheets were blackened, while the places corresponding to the apertures were unaltered.

But was the photographic impression due solely to the simple contact of the cardboard? In order to solve this question, Prof. Muraoka repeated the experiment in suppressing the metals and in leaving only the sheets of cardboard provided with a circular aperture. Upon development, the part corresponding to this aperture was black, and the parts in contact did not appear to be so dark. The juxtaposition of the cardboard and the photographic plate was therefore not the sole cause of the phenomena observed.

On another hand, upon reversing the order of the experiment, that is to say, upon placing the plates of metal directly upon the photographic plate, and the sheets of cardboard on top, the places opposite the apertures underwent no alteration, while the rest was uniformly colored. Nothing occurred, however, when there was arranged upon a plate of copper provided with an aperture a sheet of non-perforated cardboard. Besides, aluminum was more easily traversed than copper, and the latter still more easily than tin. As for the thickness, that did not seem to play much of a part. The same was the case with the color of glass, which had no influence whatever upon the transmission of light, and contrary to what occurs with the Roentgen rays, the substances that cause fluorescence were permeable to the light of the glow worm. Yet there was, as with the X rays, a certain relation between the permeability and density. Finally, the phenomena manifested themselves only when the sheet of perforated cardboard was placed either in direct contact with the photographic plate or beneath a plate of metal or cardboard that filtered for a second time the rays that had already passed through black paper. Upon increasing the number of the sheets of perforated cardboard (these being superposed one above the other), the intensity of the photographic impression was correspondingly increased.

From all these experiments, as well as from others that are not so important (for which we refer the reader to the original memoir), we have the right to conclude that the light of the glow worm depends especially upon the matter interposed. If there is nothing between the insect and the plate, the rays emitted behave like ordinary light. They are capable of being reflected, refracted and polarized.

On the contrary, the rays transmitted by the cardboard or the copper plates possess properties that are analogous to those of the famous X rays. They appear to acquire these during their passage through the "filtering" substance, and vary with the latter. They are capable also of being reflected, but are neither polarized nor refracted. Finally, what is an interesting peculiarity to point out, these "filtered" rays possess some of the properties of the ultra-violet rays as well as of the Roentgen rays. Would it not be more logical, then, to admit that the lampyris emits two kinds of rays—the ordinary luminous rays and the Roentgen ones? This luminosity, which has defied the sagacity of investigators for ages, is very curious. Prof. Muraoka has desired to lift one corner of the veil. Has he succeeded in getting any nearer to a solution of the problem? That is the question. However this may be, it is our opinion that the last word has not yet been said.—La Nature.

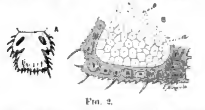


Fig. 2.

A, photogenic organs of the larva of Lampyris noctiluca; B, magnified section of one of these organs; a, granular cells; b, crystallized granulations.

THE "INDEX ANIMALIUM."

The number of species of recent animals already described has been computed by our zoological recorders as 386,000; including fossils, we may well put the number at 550,000. The number of names applied to those animals is, however, far greater. Owing to the ignorance or perversity of men, or to the gradual advance of knowledge, some animals are burdened with as many as twenty names, but—unlike "the ways of constructing tribal lays"—only one of them is right. Now, whatever be the principles that guide a systematist in determining the name that should be applied to a known species, it is clear that he must have all the claimant names before him when making his decision; and not only the names that have been applied to the species in question, but names applied to other genera and species, some of which may have received identical names. Consequently, as we have often urged, a complete list of all names that have ever been proposed is an indispensable preliminary to any effective revision of nomenclature. Such a list is the "Index Animalium," now being prepared under the auspices of a committee of the British Association.

It has already been shown in Natural Science (Jan., 1896) that the average number of names applied to each species mentioned in the British Museum Catalogue of Birds is 5¼. But on a more moderate estimate of three names to each known species in the animal kingdom, this index will have to contain no less than 1,650,000 references. The mere writing of these is almost a life's work; and to this labor must be added that of searching for scarce literature, or verifying dates—a most important part of the work—of interpreting obscure passages often in strange tongues, and of sorting

Fig. 3.—JAPANESE LADIES COLLECTING GLOW WORMS. (REDUCTION OF A JAPANESE PRINT.)

the slips into alphabetical order under genera. To this gigantic task, Mr. C. Davis Sherborn, an enthusiastic and competent bibliographer, has devoted himself. In the course of some four years he has completed 140,000 references, each on a separate slip and in duplicate. These are arranged under genera as the work goes on, so that they are always available for reference. Any zoologist can see them by applying at the library of the Geological Department of the British Museum (Natural History), and in this way or through correspondence many have already derived important help from Mr. Sherborn's labors.

Descriptions of the methods and progress of the work have recently appeared in the Proceedings of the Zoological Society (1896, pp. 610-611) and the Geological Magazine (Dec. iv, vol. iii, pp. 557-561, Dec., 1896); but, feeling that zoologists in general are not sufficiently aware of the service being rendered them, the committee has asked us to draw attention to it. We do so with great pleasure, and we earnestly trust that some practical expression of sympathy may be the outcome. The British Association was able last year to make a grant of £100 toward the work; but this does not go far, and there is no guarantee that a repetition even of this will always be practicable. To make satisfactory progress, at least £200 a year is needed, and the zoologists and paleontologists of the world should surely be able to provide that sum.—Natural Science.

THE COLOBUS VELLEROSUS.

THE COLOBUS VELLEROSUS.

OUR illustration shows a Colobus vellerosus, or silk monkey, as they are found in the territory between the Gold Coast and Dahomey, along the Gulf of Guinea. The colobi in general are remarkable for their long, silky fur, for the almost entire disappearance of the thumbs of the fore hands and for the tuft which they have on the end of their long tails. They are inhabitants of the virgin forests, where they live in companies on high trees, scarcely ever descending to the ground. They have a very clever way of hiding themselves in the foliage, by drawing together the branches beneath them. Commercially these colobi are of importance for their fur, which is imported into our civilized world, to be made into articles for winter clothing.

There are three varieties of colobi known. First there is the Colobus vellerosus, a specimen of which in the Hamburg Zoological Gardens has supplied the model for our illustration, taken from the Illustrirte Zeitung. The tuft on the end of the tail can be clearly distinguished. His cheeks are covered with a bushy white beard; the upper portion of his fore limbs is gray, all the rest of his body is black. His fur is long and silky all over. The monkey feeds on leaves, tender buds and shoots, and all sorts of fruit. A peculiarity of this particular colobus is that, when young, it is quite white, but it soon changes to the color of the adult.

A somewhat similar monkey, the Colobus ursinus, is found in Liberia and Sierra Leone. This variety has white shoulders. In the Congo State the Colobus satanas is the only representative of the class of colobi. He is, as his name implies, quite black. There are also olive colored colobi, which are characterized by a tuft of fur on their heads, and others colored variously from red to black and black and white.

THE TRUE PURPOSE OF A LARGE PUBLIC PARK.*

THE true purpose of a large public park is to provide for the dwellers in cities convenient opportunity to enjoy beautiful natural scenery and to obtain occasional relief from the nervous strain due to the excessive artificiality of city life.

By large public park is not meant one covering more than a certain number of acres, but one large enough to contain a complete natural landscape, where the boundaries will not be obtrusive; where city conditions will not be unduly apparent; where one may stroll over hill and dale, across meadows and through woods, always amid natural surroundings, for hours, without twice following the same routes; where one may come again and again without becoming familiar with all its interesting localities and natural features; where many thousands of visitors may be enjoying the scenery at the same time without crowding each other; where those who especially seek seclusion may find parts so remote from the boundaries that even if city houses are not completely hidden they become reduced in the distant perspective to inconspicuous proportions as compared with the foliage of trees and other natural objects in the foreground; so remote that the roar of street traffic is less noticeable than the rustle of foliage stirred by the breeze or than the songs of birds and insects.

That the scenery of such a park should be beautiful no one will deny, but that it should be natural needs explanation. There can hardly be such a thing as absolutely natural scenery in a public park near a large city. Fires, pasturing, cultivation, wood chopping, the destruction or driving away of the wild animals, wild birds and insects, and the introduction of others, have long since ended purely natural conditions about every large city, leaving at best only a general resemblance to natural scenery. Even if a tract of land is still to be found in a comparatively natural condition while in private ownership, it could not remain entirely in that condition after being properly fitted for and used as a public park.

With these limitations in mind, what is meant by the natural scenery of a large public park may be itemized as ordinarily either open meadow, open grassy hillsides or rolling ground, open groves of trees with good turf, dense woods, borders of shrubbery, or low woody or herbaceous undergrowth, water in river, brook, pond or pool, and more rarely cliffs or ledges of rock. These principal features of the scenery again may be divided into their elements of earth or rock surface, water surface and foliage, either ground cover, shrubbery or trees.

In most cases a good deal of grading needs to be done in places. The original natural surface is wholly or partially destroyed and a new surface is created artificially, but it should be so shaped and finished as to appear natural, or, at least, as closely in harmony with natural surfaces as study and care can make it. Too often, however, through lack of appreciation of the true purpose of a large public park, the grading which must be done, either ignorantly or carelessly, or owing to mistaken ideas as to economy, or owing to personal preference for artificiality, is made as regular and unnatural as possible, so that what might have been done in harmony with the natural scenery antagonizes it and greatly lessens its value for its true purpose. Abundant instances of artificial-looking grading in the wrong place exist in many of our large public parks. The responsibility of park commissioners for this sort of interference with the true purpose of a large public park is generally only in the indirect way of intrusting the work to men not properly trained in park work or by enforcing an unwise economy; for it must be acknowledged that to grade naturally and gracefully usually costs more than to grade formally and stiffly.

The water surfaces of a park need more study and care to make them appear natural in outline and as to their margins than does the general ground surface of the park. Too often park waters are almost as stiff and formal in their outlines and in the shaping of their shores as are the curvilinear distributing reservoirs of waterworks. Here, again, the park commissioners are indirectly responsible for the bad results in consequence of working without the plans and directions of a trained artist or without a foreman trained in producing natural effects in park grading.

The verdure of a large public park is what the eye rests upon almost everywhere, and it is therefore the most important of the natural elements of the scenery. The almost universal ground cover is grass, since no other plant is so well adapted to the purpose of hiding bare earth while enduring, with due care and under sufficient restrictions, the trampling of great numbers of people. But there are places where even grass will not thrive, or where a wider or more varied effect is desirable. Such cases are very generally ignored in our large public parks, owing to a lack of knowledge or of artistic appreciation of the possibilities or requirements of particular cases. If gardeners studied natural scenery more, they would almost surely discover many opportunities in parks for the application of what they observed in the country. For instance, a dense natural wood which need not be or cannot be well thinned out sufficiently to permit a good turf to be grown, so that people may properly be allowed to ramble everywhere in it, may often be rendered far more natural and interesting by planting pretty wild flowers in its margins and suitable shrubbery undergrowth in its interior. Again, steep, open banks, where it is difficult and expensive, and often unnatural, to maintain turf, can be made far more interesting by the use of low ground covering plants or shrubbery.

Relief from the nervous strain of an artificial city life is afforded in no way so agreeably and conveniently as by a ramble amid the natural scenery of a large park and by the leisurely contemplation of the landscape. There are many workers in a city who suffer more or less from nervous strain, though often they are not fully aware of it. Where a large public park with ample provisions of natural scenery has been created, it has never failed to be much frequented for this purpose and to afford untold benefit to those who use it. Not only are the quiet and seclusion obtainable in the middle of a large area necessary in affording opportunities for occasional relief from the nervous stress of our artificial city life, but they are necessary to the enjoyment of the landscape of the park. Therefore, not only should conspicuous artificial objects unnecessary for the convenient use of the park be excluded from its natural parts, but noisy and dangerous occupations and amusements should also be kept out of at least the middle portions of a large park. In order to have the essential quality of seclusion, a large park should not be attempted on both sides of a railroad or important city street if it is possible to avoid it, for even if the landscape could be made to seem continuous across the gap, the noise would almost destroy the desired seclusion of a considerable part of it. An extent of natural scenery sufficient to afford the sense of quiet and seclusion so beneficial to the city worker can only be secured where the grounds are ample, and therefore this should be the essential characteristic of a large park. It is the one vital reason for the existence of such a park. No number of small parks can possibly answer the same purpose, however useful and even necessary they may be for other reasons.

Even if the true purpose of a large park has been kept in view during the process of selecting the land, determining upon its landscape features, designing its necessary construction and plantations, it is too often lost sight of subsequently, and there is a marked tendency to artificialize the landscape. But whenever it is thought wise for a municipality to provide special attractions, these should be limited in kind and number and be carefully devised. It would not be wise or economical for a city to destroy or injure broad and beautiful park scenery by introducing artificial attractions into it when these could perfectly well be provided in the smaller squares or in special amusement grounds, which could usually be much nearer the center of population than a large park, and therefore could be used by more people more frequently and more cheaply. It is customary for cities to provide for certain kinds of amusements which are healthful and innocent, and for certain objects that are instructive and entertaining and for some that are artistic and in-

* From a paper read before the recent meeting of the Park and Outdoor Association of Louisville, Kentucky, by John C. Olmsted, of Brookline, Massachusetts.—From Garden and Forest.

spiring, and which cannot be or are not usually supplied solely by private effort. Such, for instance, are formal gardens, statuary, conservatories, botanical and zoological gardens, concert groves, electric and other fountains, fireworks and the like; also popular athletic grounds, parade grounds, ball grounds for boys, and facilities for boating and bathing. From motives of expediency, it is customary to include arrangements for some of these purposes in large public parks, but they should be placed in their borders, and in such a way that they will do the least possible injury to the more secluded parts of the scenery. Great discrimination is necessary in selecting among these objects those which will least interfere with the primary purpose of a large public park. Those forms of amusement or instructive entertainment requiring large buildings or implying much noise, or which draw large and careless crowds that would be liable to injure the grass and shrubbery and trees of the park, should be excluded. It is good policy to secure suitable lands adjoining a large park which can be held in reserve as sites for public museums, grounds for parades, fireworks, public speaking, baseball and (by flooding in winter) for skating and so on. The park in Brooklyn is exceedingly fortunate in having two very commodious public grounds adjoining it. It is greatly to be desired that other cities should do likewise.

If there were a well established and clearly recognized custom controlling what artificial features might and what should not be introduced into large public parks, such customs would develop into rules of common law. Or if there had been carefully drawn and detailed statutes passed upon the subject, or if there had been a series of decisions of courts as to what buildings and other objects could legally be introduced into public parks, their true purpose would be more clearly understood. It is true, there has been for years a statute in New York State forbidding the erection of buildings above a certain size not strictly for park purposes in any public park, but the principle upon which this law is based is so little understood that a few generous individuals recently had no difficulty in getting a special law passed which enables them, with the consent of the park commissioners, to introduce a great museum of history into one of the most beautiful landscapes of one of the most perfect large public parks in the world. The usual arguments in support of this desecration have been urged, namely, that the building is for a worthy semi-public object; that the collection it is to contain will be interesting and instructive to the public, and that the building itself will be handsome, and consequently that it will be an ornament to the park. If this argument is sound for one such building, it is equally sound for others. In that case a large public park is little more than a tract of beautiful vacant building lots which the public is temporarily enjoying as a playground until it shall be gradually required for one public or semi-public building after another. If there is no principle upon which the advocates of the first semi-public building can be refused a site, there is no logical reason for refusing sites to any subsequent projects of a like sort. The bars once let down, there will be a stampede to secure beautiful building sites free of cost for natural history, art, botanical and other museums; for armories, normal colleges, high, grammar and primary schools, and so on almost indefinitely.

MONAZITE.*

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IT has only been within the past few years that monazite has become one of the important economic mineral products, in its use for the manufacture of the incandescent mantles of the Welsbach light. Previous to that time it was considered one of the rare minerals, as denoted by its name, a derivation from the Greek, meaning "to be solitary."

The demand created by the manufacturers of the incandescent gas lights for the rare earth minerals stimulated the search for monazite, and it was soon found to exist in certain deposits and rocks, where its presence had not before been suspected, and so necessity became the mother of discovery.

Monazite is essentially a phosphate of the rare earths, cerium, lanthanum and didymium (Ce, La, Di) PO_4. It also contains, almost always, small variable percentages of thoria (ThO_2) and silica (SiO_2), which by some are supposed to be present in combination, as an impurity, in the form of thorite or orangite ($Th.SiO_4.H_2O$), while others believe that the thoria is a primary constituent, present originally as the phosphate, either in combination with cerium or as an isomorphous compound, and afterward altered to the silicate by siliceous waters.

Several typical analyses, made by Prof. S. L. Penfield,† of Yale University, are appended:

	1.	2.	3.	4.
P_2O_5	28·18	29·28	26·12	29·32
Ce_2O_3	33·54	31·38	29·89	37·26
La_2O_3	28·33	30·88	26·66	31·60
ThO_2	8·25	6·49	14·23	1·48
SiO_2	1·67	1·40	2·85	0·32
H_2O	0·37	0·20	0·67	0·17
	100·34	99·63	100·12	100·15

(1) From Portland, Conn.; (2) from Burke County, N. C.; (3) from Amelia County, Va.; (4) from Alexander County, N. C.

Monazite crystallizes in the monoclinic system. The usual crystal habit is tabular, parallel to the orthopinacoid (∞ P $\bar{\infty}$); also short columnar, and sometimes elongated in small needle-shaped crystals in the direction of the prism (∞ P). The crystals are usually well developed and free from distortion. They vary in size from microscopic needles, having a thickness of only 0·0015 to 0·0062 in., to the abnormally large and rare crystals that have been found in Amelia County, Va., 5 in. in length. The more usual size, however, lies between 0·05 and 1 in.

The cleavage is most perfectly developed parallel to the basal pinacoid (oP); it is also distinct, as a rule, parallel to the orthopinacoid (∞ P $\bar{\infty}$), and sometimes parallel to the clinopinacoid (∞ P ∞).

The mineral is brittle, with a conchoidal to uneven fracture.

The hardness is 5 to 5·5. The specific gravity varies from 4·6 to 5·3. The luster is resinous to waxy, and the crystal faces are splendent in the fresh, pure specimens, and dull in the weathered, impure specimens, the surfaces being sometimes coated with a light brown earthy substance, probably an alteration product.

The purest specimens are transparent, becoming translucent and even totally opaque in the impure varieties.

The color is honey yellow, amber yellow, yellowish brown, reddish brown and sometimes greenish yellow.

Monazite is an accessory constituent of the granitic rocks and their derived gneisses. It has been found in these rocks over widely separated regions of the earth's surface, and further search and study is liable to reveal its probable universal presence in most granites and gneisses. It has also been found in apatite, cyanite, and even in vein quartz. The main constituents of the granitic rocks (quartz, feldspar and mica) all contain the monazite as intergrowths, though it appears to be more generally confined to the feldspar. Zircon may be regarded as a constant accessory, and among the other usually associated minerals may be mentioned garnet, rutile, ilmenite, magnetite, xenotime, fergusonite, gadolinite, sphene, cassiterite, corundum, etc.

Monazite has not been found in the sedimentary rocks, although it may be present in some of these as a re-deposited mineral.

The economically valuable deposits are found in the placer sands of streams and rivers, in the irregular sedimentary sand deposits of old stream beds and bottoms, now covered up, and in the beach sand deposits along certain seashores.

In the southern unglaciated countries the decomposition and disintegration of the crystalline rocks, the original source of the mineral, have proceeded to considerable depths. By erosion and secular movement the loose material is deposited in the stream beds, where it undergoes a natural process of sorting and concentration, the heavy minerals, and among them the monazite, being deposited first and together. The richer portions of these stream deposits are therefore found near the head waters.

The beach sand deposits have a similar explanation, the concentration in this case being brought about by the action of the waves.

The geographical areas over which such workable deposits have been found up to the present time are quite limited in number and extent. In the United States the placer deposits of North and South Carolina stand alone. This area comprises about 2,000 square miles, situated in Burke, McDowell, Rutherford, Cleveland and Polk Counties, North Carolina; and Spartanburg, Greenville and York Counties, South Carolina.

The country rocks are granitic biotite gneiss and dioritic hornblende gneiss. Most of the stream deposits have been worked for gold. The thickness of the gravel beds is from 1 to 2 ft. and the width of the mountain streams in which they occur is seldom over 12 ft. The percentage of monazite in the gravel is very variable, from an infinitesimal quantity up to 1 or 2 per cent.

In Brazil extensive deposits of monazite occur in the beach sands along the sea coast. The largest of these is on the island Alcobaca, in the extreme southern part of the province Bahia.

Deposits are also found in the gold and diamond placers of the provinces Bahia (at Salabro and Caravellas), Minas Gieraes (at Diamantia), Rio de Janeiro and Sao Paulo.

In the United States of Columbia deposits of importance are reported in the gold placers of the Rio Chico, at Antioquia.

In Russia the mineral is found in the Bakakul placers of the Sanarka River in the Ural Mountains; also in the placer mines of Siberia.

In North and South Carolina the monazite is won by washing the sand and gravel in sluice boxes with a stream of water, exactly after the manner that placer gold is worked. The sluice boxes are generally about 8 ft. long by 20 in. wide by 20 in. deep. Two men work at a box, the one charging the gravel on a perforated plate fixed in the upper end of the box, the other one working the contents up and down with a gravel fork or a perforated shovel in order to float off the lighter sands. The boxes are cleaned out periodically, depending on the richness of the gravel and the consequent degree of accumulation of the concentrated monazite.

From 40 to 70 pounds of cleaned monazite per box is considered a good day's work.

Sometimes two or more boxes are used, arranged in a series of steps, one below the other

Magnetite, if present, is eliminated from the dried sand by treatment with a large hand magnet. Many of the heavy minerals, such as zircon, garnet, rutile, ilmenite, etc., cannot possibly be completely eliminated by any means of water separation, owing to the slight differences of their specific gravities.

The commercially prepared sand, therefore, after washing, is not absolutely pure monazite. A sand containing 65 to 70 per cent. monazite is considered a good quality.

Some operators endeavor to clean the water concentrated sand still further, by pouring it, after it is dried, from a small spout situated in the bottom of a hopper, in a fine steady stream from a height of about four feet on a level platform; the lighter particles (quartz, feldspar, etc.) together with the finer grains of monazite, garnet, rutile, etc. (which might be called tailings), fall on the periphery of the conical pile, and are constantly brushed aside with hand brushes; the tailings are afterward rewashed. Instead of pouring and brushing, the material is sometimes treated in a winnowing machine similar to that used in separating chaff from wheat.

Although the grade of the sand may in this way be brought up to eighty-five per cent. pure, the quantitative proportion is small as compared with the second and other inferior grades, and there is always a considerable loss of monazite in the various tailings.

It is impossible to conduct this washing operation without loss of monazite, and equally impossible to make a perfect separation of the garnet, rutile, ilmenite, etc., even in the best grades. The additional cost of such re-treatment and re-handling must also be taken into consideration.

A marked improvement in the economy and perfection of the treatment would be to size the raw material, separate the quartz and lighter minerals by jigging, and subsequently separate the heavy minerals, garnet, rutile, etc., in the jig concentrates, by passing over a Wetherill magnetic separator.* Experimenting in this direction, I have succeeded in making a practically perfectly clean monazite product, with but an insignificant loss in the tailings.

If the raw material contains gold, it will be collected in the sluice boxes or in the jig concentrates, and it may frequently pay to separate it, which can be readily accomplished by treating the wet concentrates in a riffle box with quicksilver.

The monazite in the stream beds of the Carolina fields has been practically exhausted, and the last mining operations were carried on, for the most part, in the old gravel deposits and channels of the adjoining bottom lands. These deposits are mined by sinking pits, about eight feet square, to the bed rock, and raising the gravel by hand labor to sluice boxes above. The over-lay, which may vary from three to five feet in thickness, is thrown away, excepting in cases where it carries any sandy or gritty material. The pits are carried forward in parallel lines, separated by narrow tailing banks, similar to the method pursued in placer gold mining.

It has been shown that the monazite occurs in place as an accessory constituent of the country rocks, and that the latter are decomposed to considerable depths, sometimes as much as 100 feet. However, on account of the minute percentage of monazite in the mother rock, it is usually impracticable to economically work it for monazite alone, by such a process as hydraulicking and sluicing, for instance. Where the decomposed rock is gold bearing, and this is sometimes the case, it may pay to recover the monazite as a by-product. In certain instances the decomposed gneiss, in situ, has been found sufficiently rich in monazite to warrant working it.

The value of monazite depends on its percentage of thoria, as this is the element mostly sought after by the incandescent light manufacturers. And, as the percentage of thoria is variable in different sands, the value of the sands is consequently also variable.

The only method for determining the percentage of thoria is by chemical analysis. The fluctuation of the thoria is considerable even in the same locality. It also depends, of course, in a measure, on the degree of concentration of the sand. Some monazite contains practically no thoria. The best Carolina grades carry from four to seven per cent.

The price of Carolina monazite has varied from twenty-five cents per pound in 1887 to as low as three cents for interior grades and six to ten cents for the best grades in 1894 and 1895. In 1896, the price fell so far below this mark as to render the mining unprofitable and practically cripple the industry. This was owing to the development and increased output of the Brazilian field, where the sand occurs naturally concentrated on the beach, and requires no cleaning treatment for shipping, after it is dug out. Being loaded directly into the ships' holds as ballast and transported by water, the freight costs are also considerably less.

In 1893, the output of Carolina monazite sand was 130,000 pounds; in 1894, 546,855 pounds; in 1895, 1,000,000 pounds; and in 1896, for reasons above named, it fell to 17,500 pounds.

* This paper embodies the results, in somewhat condensed and rearranged form, of previous communications by myself, which have appeared in the Sixteenth Annual Report of the United States Geological Survey, 1894-95, Part IV, and in Bulletin No. 9 of the North Carolina Geological Survey, 1895.

† See American Journal Science, vol. xliv., 1892, p. 390, and vol. xxxvi., 1888, p. 322.

* See Jour. Frank. Inst., 143, 370.

RECENT ARCHÆOLOGICAL DISCOVERIES IN THE NILE VALLEY.

M. JACQUES DE MORGAN, the director-general of antiquities of the Egyptian government, has just forwarded to his brother, M. Henri de Morgan, of this city, particulars of his latest find in the ancient Nile Valley. The letters tell of one of the greatest Egyptian discoveries that have ever been made. They describe the finding of the tomb and mummified body of Egypt's probable first king, who is supposed to have reigned 4800 B. C., or almost seven thousand years ago. According to archæologists, the importance of this discovery cannot be overestimated. M. de Morgan is one of the greatest Egyptian explorers. Many finds of inestimable value can also be placed to his credit, and a large portion of the contents of the imperial museum of antiquities at Gizeh evidences his success in ancient Egyptian discoveries. During the greater part of last year he paid special attention to the study of prehistoric man in the Nile Valley; and in that portion of the valley formed by the bend in the Nile between Thebes and Abydos he unearthed many of the oldest records pertaining to early Egyptian history that have yet been found. From these records it became apparent that at one time, in the extremely remote past, Abydos was the capital of Egypt and the city that contained the tomb of Osiris, the oldest tomb of which tradition speaks. It was to investigate over again this remarkable ground that M. de Morgan began his search. Working steadily by means of trenches and soundings, the first notable discovery was made in the shape of ancient flint arrow heads. These were of the most remarkable kind, and evidently belonged to a period considerably antedating the time of the fourth dynasty, which up to this time had been the most remote age of which science had any record. Other implements were found in the shape of indented flint blades, which had probably been used as saws and sickles. This was determined from the fact that wheat is believed by historians to have grown wild in Egypt at the time of the first dynasty, and the shape of the implements found indicates clearly that they were used for harvesting this wild cereal. A complete specimen of one of these sickles, in its wooden setting, was found deeply buried in the sand. This sickle indicates that the people of the first dynasty were advanced in the art of agriculture, as well as accustomed to the use of flint tools.

M. de Morgan also found evidences that these ancient people had a religion of their own, in the shape of slate figures of fishes, birds and turtles, which he dug up. He believes the religion to have been a sort of fetishism, as he can in no other way explain the curious images. Regarding this point he says: "These figurines must have belonged to either the first dynas-

ty or to a race and period preceding it, as I have found them only in these autochthon places. Of this fact there is no doubt, as the figurines were unearthed under my own eyes, and I must add that not in any of the other old tombs of the ancient empire that have been discovered have I ever found the slightest fragment." Continuing his soundings and study of the ground, M. de Morgan slowly made his way along the valley until he reached a point near Negada, where an extraordinary mound attracted his attention. So out of the usual nature of the ground was it that he determined upon an investigation. Excavations were begun at the base of the north side of the mound and revealed the existence of a huge quadrangular shaped tomb. As soon as this discovery was made a camp was established and work commenced in earnest. Numerous attempts were made to pierce the solid sides of the tomb, which from the nature of the surroundings, the explorers believed to be intact. Finally, on one side an opening was made, which was gradually enlarged to the size of a large doorway. Long, gloomy passageways descended down into subterranean depths. They passed through the rows of wonderfully carved columns, down the hollow passageway, to the caverns below. From top to bottom the walls were covered with hieroglyphic inscriptions, and cut deeply into the surfaces were outlined the figures of men and animals that had lived and died five thousand years before the Saviour walked the earth. Strange characters of warriors, different from anything seen in other tombs, stood out in bass-relief, and the images of children, kneeling as if in fear, appeared here and there on the sides of the passageways.

Taking the main aisle, they followed it by torchlight, and found that it led into a series of rooms. In all there were twenty-one of these rooms, each containing many objects. In the center of each were placed sarcophagi containing the mummified remains of the dead, and around them were scattered many objects of the utmost antiquity. There were a number of pieces of what had once been furniture, in several different designs, and here and there fragments of bronze statues lay in the dust. In almost every one of the rooms a quantity of broken vases was found. These bore evidences of having been made of alabaster or some similar stone, and were of the most peculiar and wonderful designs. Still other vessels were found cut out of the hardest materials, such as rock crystal and quartz. How these remarkable people managed to cut such hard substances, or the methods and tools they had for doing it, is a mystery. There were a number of implements found in several of the rooms, but they were all of flint. It is nevertheless evident that they must have possessed some other instrument, harder even than flint, to have been able to make such carvings. Several vessels made from a substance resembling obsidian were also found. From one room to another the explorers went until they discovered a large central room. In the center, upon a pedestal of solid rock, rested a single huge sarcophagus. Around it, rudely carved in ivory, were the forms of fishes and dogs in strange and grotesque shape. Near the feet were the remains of what appeared to have been a mammoth lion, made of countless pieces of ivory mysteriously put together. The sides of the room were covered with inscriptions of a period so remote that interpretation was impossible. At the head of the great sarcophagus and facing it was the life size statue of a man carved in wood. The explorers then opened the sarcophagus and exposed to view the inner mummy case, which was covered with hieroglyphics. So important was this discovery that no attempt was made to open the mummy case for fear the body, coming in contact with the air after being sealed up for so many centuries, would at once crumble into dust. The sarcophagus was again closed and sealed, after which it was prepared for removal to the museum at Gizeh, where the body will be carefully unwrapped.

Attention was then devoted to the sarcophagi in the other rooms, all of which were supposed to contain the bodies of royal persons. These have also been removed to the museum, where they will be opened. M. de Morgan then began the removal of the various articles from each of the rooms. In all of them he found large urns tightly closed and having on the top what is known as a "banner name," or the seal of the King. The presence of these "banner names" is regarded by archæologists as conclusive proof of the great antiquity of the tomb. The large wooden statue in the king's chamber was next studied. It was finely proportioned and was placed at the head of the sarcophagus in order to provide a resting place for the king's soul in case anything happened to injure the body. M. de Morgan says that the rulers of these early dynasties deemed it absolutely essential that their bodies should exist in a perfect condition until the time of the corporeal resurrection of the royal dead. According to their belief, the living man consisted of four parts—a body, a soul, an intelligence, and an appearance, or double. Death disassociated these four parts, which, according to the belief, would ultimately be reunited for all time. If upon the return of the soul the real body was in any way injured, the soul immediately took refuge in the wooden image. The inscription on the walls of this wonderful tomb, like those of a later date, pictured the achievements and elaborate funeral rites and texts of the royal inhabitant. They showed him in the height of his glory and again lying in mummified form. A series of pictures represented the body being conveyed on a great sledge across a sacred valley to the tomb. The sledge was drawn by oxen and men and followed by many mourners. The pictures indicated that at that period of the world's early history the greatest ceremony of a king's life was his funeral, and the ceremony must have extended over a great many days, judging from the gorgeous rites that were performed. The ceilings of all the passageways and rooms in the great tomb were lined with what appeared to be sun-dried brick, although the bricks were of very coarse workmanship. The pavements of the floors were of granite, and here and there were traces of wooden coverings. Until this discovery by M. de Morgan, nothing had been found to throw any light upon the beginning of Egyptian history.—The New York Herald.

A bronze statue of Marcello Malpighi has been erected at Crevalcore, near Bologna. The Royal Society sent an address of congratulation, Malpighi having contributed many valuable papers to their Transactions.

THE DANGER IN VEILED STIMULANTS.

THE medical profession and the laity have been accustomed for so many years to the abuse of alcohol as a nervous stimulant that some persons have become hardened to the miseries which it induces, while others have been stimulated to its excessive condemnation. As a result of this and of the general desire for stimulating foods or drugs, a very large number of persons have been led to place before the public other powerful nervous stimulants, of which both the medical profession and the laity know less than they know of alcohol, until at the present time there are almost as many consumers of nervous stimulants other than alcohol as there are of those who use alcohol to excess. Further than this, the number of these substitutes is daily increasing, and in many instances unprincipled venders are fortifying comparatively innocent and solid nervous stimulants, dispensed for common use, with so large a quantity of alcohol added that the patient really becomes addicted to the alcohol habit. The object of this is not, however, to direct attention to these preparations or to the evil effects which they produce, but rather to make clear the fact that all of them are but temporary makeshifts which in the end, in the vast majority of cases, materially increase the discomfort and the ill health of the person who takes them.

The abuse of these remedies by the profession is not so much the result of ignorance as of carelessness. There is no drug yet discovered, so far as we know, unless it be alcohol, which distinctly adds force to the body when it is taken. All of the so called "strengthening remedies," which enable a man to accomplish more work when he is under their influence, do this, not by adding units of force to his body, but by utilizing those units of force which he has already obtained and stored away as reserve force by the digestion of his food. Kola, coca, excessive quantities of coffee and tea, and similar substances, while they temporarily cause nervous work to seem lighter, only do so by adding to the units of force which a man ought to spend in his daily life those units which he should most sacredly preserve as a reserve fund. The condition of the individual who uses these remedies when tired and exhausted, with the object of accomplishing more work than his fatigued system could otherwise endure, is similar to that of a banker who, under the pressure of financial difficulties, draws upon his capital and reserve funds to supplement the use of those moneys which he can properly employ in carrying on his business. The result in both instances is the same. In a greater or less time the banker or the patient, as the case may be, finds that his reserve fund has disappeared and that he is a pecuniary or nervous bankrupt.

Even the advertising boards and fences of the cities, towns and country now contain advertisements which mislead the ignorant into the idea that, by using the drugs named thereon, they will actually increase the development of their muscular power, when in reality the final result of such a course must be to decrease the nervous stamina which the would-be athlete so earnestly desires.—Therapeutic Gazette.

THE ETIOLOGY OF YELLOW FEVER.

E. KLEIN, in Nature.

YELLOW fever is an acute infectious disease, endemic in the West Indies, the shores of the Mexican Gulf, and in some parts on the west coast of Africa, whence the disease has been repeatedly transported into other localities, causing epidemic outbreaks. Like other infectious diseases, yellow fever is supposed to be caused by a specific living entity which, invading a predisposed person, multiplies there and causes the peculiar pathological changes in the gastro-intestinal tract and the liver characterizing yellow fever. Within recent years the supposed specific microbe has been discovered several times. Dr. Domingos Freire, of Brazil, and Dr. Carmona y Valle, of Mexico, have announced such discovery, but Dr. Sternberg, of Washington, who has himself studied the disease on behalf of the United States government, has shown that none of these discoveries is a reality, and after a prolonged investigation, including the examination of a great many cases affected with or dead from the disease, has arrived at the following conclusions, embodied in a lengthy report to his government: that none of the different species of bacilli and cocci, present in the intestinal canal, in the blood, the liver and other tissues of persons affected with yellow fever, can have a claim to be considered as the specific microbe; that in a number of cases the examination, microscopic and cultural, of the blood and tissues yielded no bacteria recognizable either by the known methods of staining or culture; and he finally implied that the specific microbe of yellow fever is most probably not of the nature of a bacterium at all. After these very definite conclusions by Dr. Sternberg, it came rather as a surprise when, some months ago, the announcement was made that Dr. Sanarelli, Professor of Experimental Hygiene in Montevideo, formerly in the Pasteur Institute in Paris, had discovered the true cause of yellow fever in the form of a bacillus, Bacillus icteroides. This surprise is still further heightened by the statement in Dr. Sanarelli's lecture, that the Bacillus icteroides is demonstrable by the ordinary methods of staining and by culture in the ordinary well-known media. The morphological and cultural characters of the bacillus show it to belong to the group of coli-like bacilli; it is rarely demonstrable in a pure state in the blood or tissues, being generally associated with a more or less copious admixture of other microbes—Bacillus coli communis, streptococci and staphylococci; as a rule it is present only in small numbers in the capillary blood vessels of the liver, spleen and kidney. It reflects great credit on the perseverance and sagacity of Dr. Sanarelli to have been able, notwithstanding all these difficulties, to select out the Bacillus icteroides, and to have by animal experiment been able to demonstrate, at least, as highly probable that the Bacillus icteroides is the true microbe of yellow fever. As mentioned just now, the distribution of the microbe in the affected person, its morphological and cultural characters, do not in themselves offer strong prima facie evidence, and Dr. Sanarelli himself fully recognizes this; but when we come to the experimental evidence which he furnishes, the evidence as to the Bacillus icteroides being the specific cause of yellow fever assumes considerable power.

In the first place, Sanarelli shows that dogs, goats and horses are susceptible to infection both with the living bacilli as also and particularly with the highly poisonous toxin produced by the bacilli in broth culture; the symptoms and anatomical lesions hereby produced in these animals in the intestinal tract, the liver and the kidney, bear a striking resemblance to those of yellow fever in man. In the second place, Sanarelli furnishes proof that the toxin produced in broth culture—and separated from the bacillary growth by filtration through a Chamberland filter—when injected into healthy persons causes a prompt reaction in the form of severe disturbance, primarily of the intestinal tract, but also, further, of the general system closely resembling that in yellow fever. It is to be hoped, nay, it may be assumed as certain, that in continuing his investigations Dr. Sanarelli will ascertain the action of the blood of human beings, who have passed through and recovered from the disease, on the Bacillus icteroides. This disease, as is well known, very rarely occurs twice in the same person, and it is therefore highly probable that, as is the case in other similar infectious diseases, the blood after a single attack possesses agglutinating action (in vitro), or germicidal action (in corpore), or both on the culture of the specific microbe. If on further investigation the blood serum, after an attack of yellow fever, should be found to show such positive actions on the Bacillus icteroides, a strong support will thereby be furnished as to this bacillus being the specific microbe. It will be the crowning of prolonged and laborious studies if Sanarelli by experiments on immunization of animals—the horse being evidently well fitted for such immunization—did, as is highly probable that he will, obtain antitoxic serum by which yellow fever can be successfully combated both prophylactically and therapeutically.

ORIGIN OF FAT IN THE BODY.

THE subject of the origin of fat has once more been taken up by the experimentalist. Many years have now elapsed since the well-known French chemists, MM. Dumas and Boussingault, as the outcome of their researches, maintained that animals, whether herbivorous or carnivorous, were supplied with all their proximate principles by the vegetable kingdom—the former class directly, the latter indirectly through the herbivora on which they preyed. Animals, according to these observers, did not make fat, sugar or albumen, but derived each and all of these substances from plants. This position was contested by Liebig, who contended in regard to fat that this was not altogether obtained by animals from the fat of their food. On the contrary, they were able to make it with either sugar or starch. He pointed out, as Huber had done before him, that bees fed on sugar or honey alone were capable of forming fat in the form of wax, but Huber had omitted to weigh the bees before dieting them, and Dumas and Boussingault ingeniously argued that the wax formed on a diet of pure farina or sugar was originally stored up in the bodies of the bees and utilized by them in the construction of their combs. Liebig therefore still supported the view of Huber, and held that the greater part of the fat which is deposited in the animal body and that which is found in the milk of nursing mothers is formed in the body and almost exclusively from the hydrocarbonaceous compounds of the food. The albuminoids, he thought, played quite a subordinate rôle from this point of view, as, indeed, seemed probable when it was considered that the food of the herbivora which store up much fat is chiefly composed of carbohydrates, while the bodies of the carnivora, whose food is chiefly albuminous, contain little or no fat. Moreover, he experimented on a goose, which from a lean condition was fattened to such an extent that three pounds of fat was obtained from it, although the maize with which it had been fed did not contain anything like that quantity of fat. Dumas and Boussingault returned to the charge by making a careful analysis of the food given to a cow for a year and determining the quantity of fat which the animal yielded in the milk. They found the fat introduced with the food to be considerably in excess of that eliminated by the milk, but Liebig scored a point by observing that nearly all the fat ingested with the food escaped undigested from the bowels in the feces. Subsequent experiments, especially those of Lawes and Gilbert, on the herbivora clearly demonstrated that one, at least, of the sources of fat is the farinaceous material ingested. In the meanwhile various circumstances had led some investigators to adopt the view that the albuminoid or nitrogenous constituents of the food might play a part in the generation of fat.

Thus it was found that animals fattened best when their food, if chiefly farinaceous, was mingled with some albuminous compounds; while Pettenkofer and Voit demonstrated that in a dog freely supplied with flesh the whole of the nitrogen thus introduced into the economy was recoverable from the urine and feces, while the carbon remained in the economy and hence, probably, formed or aided in the formation of fat. The observations of Kemmerich on nursing bitches, of Subbotin of feeding dogs with palm oil and meat, of Hofmann on larvæ fed on defibrinated blood containing a known quantity of fat, all pointed in the same direction and led Voit to maintain, first, that the fat of animals is exclusively formed from the proteid aliments, and secondly, that hydrocarbonaceous compounds are not converted into fat in the animal organism, but simply preserve from oxidation the fat formed from the proteids. The latest researches on this point, however, are not quite in accordance with Voit's views. The most recent observer, Dr. Kaufman, arrives at the following conclusions: The proteids, in common with the ternary compounds of the food, contribute to the formation of fat, but, contrary to Voit's statement, they are not the exclusive origin of it. When, during digestion, a large quantity of proteids is absorbed it rapidly undergoes disintegration and forms fat. This fat has, speaking generally, three applications. One part oxidizes and, passing through the phase of glucose, supplies the requisite energy for the general physiological work of the organism; another part undergoes incomplete oxidation and is transformed into carbohydrate which is stored up in reserve as glycogen; while the third part remains intact and is deposited as fat. The proportion of fat which is fixed during the digestion

period varies with the abundance of the repast and the richness of the organism in glycogen. If the animal is poor in glycogen, it may happen that the whole of the non-oxidized fat may be converted into glycogen. Calorimetric investigations demonstrate that if the anaerobic decomposition of albumen really occurs, the process is not attended with any disengagement of heat.—Lancet.

THE SKIN AS A DIAGNOSTIC FACTOR IN DISEASE.*

THE design of this paper is to deal with the conditions in which the state of the skin is liable to mislead the physician as to the cause of the illness of the patient. Sometimes, too, we are too much inclined to treat the skin affection as the only lesion of importance, and fail to connect it with the underlying condition of the system which is largely responsible for its development. These underlying provoking or predisposing agents are exceedingly numerous, and are perhaps best summed up or described in a very original manner by Dr. Stephen Mackenzie as follows: The seven stages of man could be well illustrated by diseases of the skin, though we lack a Shakespeare to do justice to the theme. In the "mewling and puking" infant we meet with sclerema and edema neonatorum, the "red gum" or strophulus of the older writers, intertrigo, eczema, urticaria papillosa (lichen urticatus), urticaria pigmentosa, xeroderma pigmentosum, and impetigo; "the schoolboy," with his chilblains and ringworm, alopecia areata, pityriasis rosea, ecthyma, and "football disease;" and then the "lover," with his acne and sycosis; and then the justice, with acne rosacea, diabetic boils, and pruritus ani; the sixth stage shifts into the "lean and slippered pantaloon," with rodent ulcer and "gouty" eczema; "last scene of all, sans teeth, sans eyes, sans taste, sans everything"—except an incessant and intolerable itching of the skin which we call senile prurigo.

Aside from these dermal manifestations of systemic states I believe that too little importance is given to the very common lesions of the skin following the use of drugs. The moment we leave the cases in which the eruption seems to arise without apparent cause, and approach the question as to the eruptions which may be produced by drugs, we pass into an almost limitless field. Only a few of the moderately common accidental rashes can be considered in the short space that can be devoted to this paper. As a rule, we are apt to regard iodoform as a very innocent substance, rarely producing untoward effects unless its application is exceedingly free, and then causing only general systemic symptoms of poisoning rather than skin manifestations. Usually this iodoformic rash appears when the drug is freely applied over a large surface, coming out generally within a few hours after the iodoform is applied (Meunier) and rarely after the twelfth day (Taylor).

It is a well-known fact to many more physicians than those who know of iodoform rashes that quinine is very apt in certain persons to produce skin eruptions of all kinds and varieties. In France, articles by Grellety, Dumas, and theses by Bonvard du Grissac and Levassor have recorded many cases, and a very large number of Americans have done likewise. Guirard states that in most cases, simultaneously with the ordinary symptoms of cinchonism, we have developed a roseola, a simple erythema, or a marked scarlatinal erythema. In other cases an acute eczema or urticaria comes on. I have seen this so-called quinine rash more than once. Usually the eruption is widely diffused, but, if limited, it may be found only about the breastbone or groin. If the eruption appears on the face, it is usually a tumefaction or edema. Its development is rapid and it soon reaches its greatest intensity, rarely persisting more than seven or eight days after the drug is stopped. Desquamation nearly always occurs. A differential point of value is that the eruption appears a second time if another dose is given.

Opium, on the other hand, is not usually suspected of causing eruptions on the skin. As a rule, the eruptions produced by it are limited to the face, but sometimes they are generalized. More commonly they are true erythemata and sometimes scarlatinal in type. In some cases there may be great redness of the skin, abundant sweating, acceleration of the pulse, heat of the skin. According to Brugisser, these symptoms often ensue after small doses, such as ten drops of laudanum. Finally we may discuss the skin lesions produced by turpentine. These follow both its internal and external use. As long ago as 1824 Barbière, in his work on "Materia Medica," and in 1841 Galtier, in a similar volume, described the onset of erythematous rashes, vesicles, and papules of very fleeting character after the ingestion of turpentine. Trousseau and Pidoux, in their book on "Therapeutics," have done likewise, but all these occurred after large amounts of the drug had been used or after its external employment. In 1879, however, Cordes published an early case of true turpentine rash following its internal use. In this instance a patient of thirty-four years, after the ingestion of turpentine, developed an erythema over the skin of the trunk. Another case observed by the same author was that of a woman who developed a marked urticaria under similar circumstances. In both these cases the eruption was very fleeting in duration.

The conclusions reached by Guirard are as follows: that medicinal eruptions are commonly limited to the face, afterward extending to the trunk symmetrically, and usually developing suddenly, as does erysipelas. Unless they arise from very large doses, they generally develop without being associated with general systemic symptoms. He thinks that the absence of these symptoms aids us in separating these cases from the infectious diseases. The eruptions due to drugs often change from one type to another, particularly those due to the balsams. The eruptions are usually sudden in onset and develop rapidly.

The word temper, as used in steel manufacture, means the percentage of carbon which the metal contains. For instance, in steel of razor temper, there is 1½ per cent. carbon; saw file temper, 1¼ per cent. carbon; tool temper, 1⅛ per cent.; spindle temper, 1¼ per cent.; chisel temper, 1 per cent.; set temper, ⅞ per cent.; and die temper, ¾ per cent. of carbon.

* H. A. Hare, M.D., in the Medical Record, New York. Condensed for Public Opinion.

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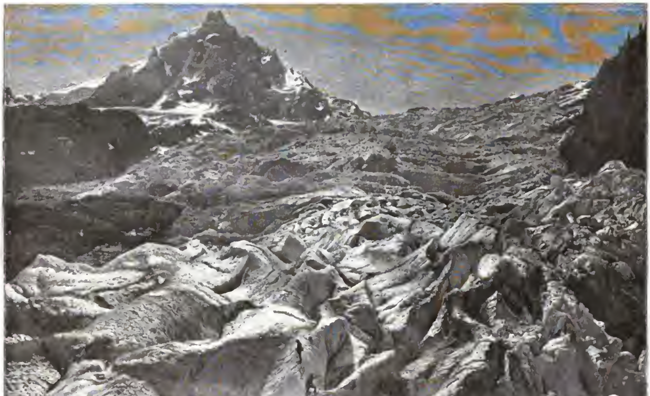
THE JANSSEN OBSERVATORY ON THE SUMMIT OF MONT BLANC.



THE BOSSON GLACIER AND THE AIGUILLE DU MIDI.

MONT BLANC.

THAT portion of the Alps in which is located Mont Blanc is characterized not only by the fact that within it lies the highest point of Europe, but by a striking peculiarity in its formations. Its wealth in unusually fine glaciers, the number of so-called séracs (ice needles), scattered over it, and its aiguilles are quite typical of the region.

The nature of the séracs and the difficulties met with in their ascent are well brought out in one of our cuts, which shows a party of tourists, led by experienced guides, slowly making their way up one of these ice blocks on Mont Blanc. But still harder to reach than the tops of these séracs are the summits of the aiguilles.

It is said that, after an ascent of some of them, the summit of Mont Blanc is reached with relative ease. One of these aiguilles, the Aiguille du Midi, is visible in the background of our second illustration. In the foreground extends the Bosson Glacier, one of the finest of that region. A striking characteristic is its rugged surface. Over its ridges we see proceeding a party of tourists, roped together and equipped with alpenstocks. A little hut at Pierre Pointue, on the way to the summit of Mont Blanc, commands a fine view over the glacier and its surroundings. Here, at a height of 6,650 feet, tourists rest on their ascent.

The view spreads over to the aiguille and the Dôme du Goûter, both covered with snow, and nearer by lies the little town of Chamonix. From Chamonix the ascent to Mont Blanc is often started. The way leads past the place where the Glacier de Taconnaz joins the Glacier des Bossons. This place is commonly known as the Passage de la Jonction. We reproduce a view of the spot. Two tourists are seen making the somewhat dangerous passage, linked together by a rope.

We have brought before our readers some scenes as the traveler meets them on the ascent of Mont Blanc. We will close with a few words to accompany our first illustration, which shows the aspect of the spot where the tourist finds his goal reached. On the summit of the Alpine giant, amid eternal snow, is built a little stone house, the Janssen Observatory. Small as it is, it represents a great enterprise. In August of the year 1890 Janssen, the distinguished Paris astronomer, was sent by the Meudon Observatory to ascend Mont Blanc with a view of making meteorological and spectroscopic researches. He started with twenty-two guides, and the necessary equipment, and successfully completed the work. The immediate result simply confirmed the observations made by an expedition two years before. But indirectly the expedition of 1890 also gave the first impulse toward the erection of an observatory on the summit of Mont Blanc. Janssen himself was the originator of the scheme; he secured the interest of several eminent men of France, among them the then president. A committee was formed to transact the business in connection with the enterprise, Janssen being president. As it came to the actual erecting of the building, the little hut of the engineer Vallot, half way up Mont Blanc, was found to be of great value as an intermediate station.

In 1891 a preliminary experiment was made—a wooden hut was built on the site of the finally erected observatory. The experiment succeeded beyond the expectations of the builders, and soon the foundations for the observatory proper were laid. The house was made two stories high, the lower floor being below the surface of the snow, on one hand to make the house more stable, and on the other to obtain a somewhat moderate temperature in the bedrooms on the ground floor. The house was rested on screws, which were let into the snow, and which permitted of leveling it in case the snow should alter its position. This plan was conceived by Janssen, and approved by Vaudremer, the architect of the Academy of Fine Arts, of Paris. The material was conveyed to its destination in eight hundred lots, weighing, together, about thirty thousand pounds. This work was begun in the summer of 1892, and, thanks to the comparatively fine weather that prevailed during its continuation, the construction was completed on September 8, 1893. At seven o'clock in the morning of that day Janssen started from Chamonix to the observatory, where he arrived on the 11th at two o'clock in the afternoon. He took up his work at once, investigating the solar spectrum with regard to the question of the presence of oxygen in the sun.

Our illustration is reproduced from a water color

A LITTLE HUT AT PIERRE POINTUE ON THE WAY TO THE SUMMIT OF MONT BLANC.

PASSAGE DE LA JONCTION, ON THE ASCENT TO MONT BLANC.

painting by Janssen himself. The observatory is situated at a height of 15,682 feet above sea level.

Our illustrations are taken from Illustrirte Zeitung.

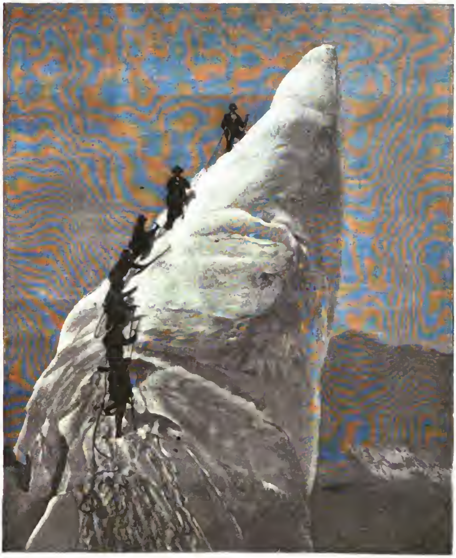
THE ISLAND OF SAKHALIN.*

ALTHOUGH the remoteness of Kamchatka has, to a certain extent, familiarized us with, at any rate, the name of that dreary peninsula, the adjacent island of Sakhalin in the North Pacific Ocean still remains, to the majority of English readers, a sealed book. Of late years, however, its increasing importance as a place of exile for Russian political and criminal offenders has invested Sakhalin with a certain interest, derived, perhaps, more from penal associations than physical resources, which latter may, when fully developed, materially affect trade and commerce in the far East.

The island of Sakhalin is 584 miles in length, its breadth varying from 18 to 94 miles. The southern extremity is separated from the island of Yeso, twenty miles distant, by the Straits of La Perouse, and its western coast by the shallow Gulf of Tartary (at one point barely five miles across) from the mainland of Siberia. Although Dutch explorers are said to have landed here in 1643, the first reliable survey of the island was probably obtained in the year 1787 by La Perouse. Russian fur traders followed in the early part of the present century, but it was only in 1853 that, disturbances having occurred with the natives, a score or so of Cossacks were stationed at Dui, on the west coast. In 1867 negotiations were entered into by the Russian and Japanese governments for joint occupation of Sakhalin, but the subsequent discovery of coal, and consequent influx of Russian convicts, rendered this arrangement highly unsatisfactory. Further negotiations therefore ensued, with the result that, in 1875, the island was formally ceded to Russia, Japan receiving in exchange the entire Kurile Archipelago.

Sakhalin is by no means easy of access. Even during the open season (from May to September) but very few vessels visit the island, and, with the exception of the monthly arrival of convict ships from Europe, and a couple of small Russian trading steamers, there is no fixed service with Vladivostok, which, with the exception of Nikolaefsk, is the only Siberian port whence Sakhalin may in three days be reached. During the winter months the island is completely icebound and unapproachable by water. Communication with the mainland is then maintained by means of dog sledges, and the mails for Europe are dispatched across the frozen Gulf of Tartary—a journey, under favorable circumstances, of about three months. One of the chief disadvantages connected with the island is that it does not at present possess a single harbor worthy of the name. The two principal ports, Alexandrovsky-Post and Korsakovsky-Post, are simply open, unprotected roadsteads, whence on the approach of stormy weather vessels must immediately put to sea. With convict labor, however, and abundance of necessary materials at hand, this should not be a serious difficulty to overcome. It has even been estimated that at Alexandrovsky-Post, on the western coast, a sheltered and secure anchorage could be constructed at a comparatively moderate outlay.

Sakhalin is mountainous, but the ranges, which run chiefly north and south, attain no great altitude, the highest peak, Mount Tiara, being scarcely 5,000 feet above sea level. The island is badly watered, there being only two rivers (the Tym and the Poronai) of any importance, and navigable for small craft for over a hundred miles. More than two-thirds of the island are covered by dense forests, chiefly coniferous, although the elm, poplar and maple are found in some districts, and bamboo is common in the uplands of the south. The climate is very variable. Winter lasts for about one hundred and ninety days, the mean temperature at this season being below freezing point. Spring commences about the middle of April, although, even in May, the thermometer has been known to fall as low as 21° F. Summer is as bright as it is brief, and the average temperature of the center of the island is then 80 to 85° F. The air at this season is mild and delicious, the sky blue and cloudless, and the grassy valleys carpeted with fragrant wild flowers. Some time before his visit the writer had read that* "agriculture and gardening are impossible in the vicinity of Dui," and was, therefore, surprised to find that roses and geraniums flourish in the gardens of Alexandrovsky-Post, barely ten miles from the place in question. The warm season, however, is of very short duration; autumn, with her curtain of clouds and rain, veils the summer sunshine with fatal rapidity, and by the middle of August the island is generally shrouded in dense gray mist. By the end of October the coast is again ice bound, and the whole island covered with snow several feet deep, which seldom entirely disappears until the following May. Notwithstanding these sudden and severe climatic changes, Sakhalin is not unhealthy, and, while prison statistics point to the predominance of rheumatic complaints, epidemics are of rare occurrence, and the death rate is low. Cholera is almost unknown.



SÉRAC ON MONT BLANC.

According to the last census, taken in December, 1891, the settled population of Sakhalin numbered 19,644 souls, of whom 16,416 were Russians and the remainder Gilyaks and Ainos, or aboriginal tribes. The former, who are closely allied to the races inhabiting the banks of the Amur River in Eastern Siberia, lead a precarious existence, dwelling in winter in small settlements along the coast, and in summer leading a nomadic existence hunting and fishing. The Ainos, who originally came from Japan, now inhabit Yeso and the Kurile Islands, and are distinguished from the Gilyaks by their swarthy complexions, long faces and extraordinary hirsute appearance. Both tribes are, on Sakhalin, rapidly dying out. Of wild animals the bear, wolf and lynx are numerous in the forests. The elk is met with in the interior, and sables are caught in the north in considerable quantities, though their skins are of a very inferior quality. Horses and cattle have been imported from Siberia, but, although the former thrive and do well, the latter suffer much from climatic influences, and have as yet proved unsatisfactory. For sleighing purposes, dogs, and occasionally reindeer, are employed.

Sakhalin is, for administrative purposes, divided into three districts, viz., Korsakovsky-Post in the south, Tymovsk in the north, and Alexandrovsky-Post on the western coast. The latter, which is situated in the center of the coal district, is a picturesque, straggling town of about 7,000 inhabitants, consisting almost entirely of officials and convicts. This is the most important penal settlement on the island, contains the largest prison, and is, moreover, the residence of the governor of Sakhalin, a subordinate of the governor-general of Eastern Siberia. Alexandrovsky is garrisoned by about 1,500 men, and contains large foundries and workshops for convict labor, but most of the prisoners are employed in the adjacent coal mines of Dui. The coal is excellent for steaming purposes, but, owing to the difficulties of transport that at present exist, somewhat dear, and it cannot now be delivered for less than 12 rubles per ton at Vladivostok. The output in 1890 was 2,400,000 tons. Korsakovsky-Post, on the south coast, is the next largest settlement, containing about 5,000 convicts who are chiefly employed in agricultural pursuits.* Although it may seem a paradox, the remaining prisons in the interior of the island, Derbynskaya, Rykovskaya and Onor, are not prisons at all, but huge wooden barracks, innocent of bolts and bars. Here, also, the work done is solely agricultural.

Prison life on Sakhalin is undoubtedly harder than on the mainland of Siberia, but, on the other hand, the actual confinement is of much shorter duration.

There are three classes of prisoners, viz.:

(1) Convicts who, having served their time in prison, are free to live in a certain district and earn their own livelihood.

(2) Convicts confined in prison, and compelled to work in the mines, foundries, or at agricultural labor.

(3) Convicts confined to prison in chains.

The latter, of the dangerous class, are naturally kept under strict supervision and subjected to the most severe discipline. An ordinary criminal, however, sentenced to a term of, say, twenty years penal servitude, may by good conduct regain his provisional liberty in a quarter of the time. The state then provides him with a log hut, a plot of land and agricultural implements, and the district to which he is assigned becomes his prison. He is, practically, a free colonist whose wife and family may, if so disposed, join him, a free passage out from Europe being granted them by government. Political exiles are rarely sent to Sakhalin. At the time of the writer's visit there were but three residing at Alexandrovsky-Post.

Many of the better educated men in the first class occupy positions as government clerks, and earn as much as 50 rubles per month. Others find employment as domestic servants, night watchmen, storekeepers, or by working at the trade they have learnt in prison; but the majority prefer to accept the grant of land they are entitled to and take to farming.

Should a convict of the first class attempt to escape, he is immediately replaced in class 2, or, if violent and refractory, relegated to class 3.

The prisons are rough log buildings, cleanly and well ventilated, and the food provided amply sufficient, a convict of even the third class receiving meat four times and fresh fish three times a week. The hospital arrangements are, although primitive, satisfactory, and every prison contains a good school for children of both sexes.

Important changes have taken place of late years in the Siberian exile system, and the conditions under which Russian convicts now travel overland differ essentially from those of even a decade ago. It is now, moreover, probable that the long tramp across Asia will shortly be abolished altogether. All political and criminal offenders will then be transported direct by sea from Odessa (via the Suez Canal) to Sakhalin, and will thus be spared the fatigue and privations that must, even under the most favorable circumstances, attend the journey through Siberia.

Although the two principal towns on Sakhalin are connected by an overland telegraph wire, the interior of Sakhalin is comparatively unknown. Several rough tracks lead from the western coast to inland Gilyak settlements, but these are almost impassable for Europeans. There is only one road of any importance (about fifty miles long) leading from Alexandrovsky to the free convict settlements of Derbynskaya and Rykovskaya.† Here the land has been extensively cultivated, and the contented looking colonists and neat homesteads speak well for the Sakhalin prison administration. Of the 20,000 acres of cultivated land on the island, nearly half is clustered around these pretty villages, where corn and vegetables are grown in large quantities, while hay is actually exported to Japan. It is said that the most fertile districts have not yet been opened up, and that the soil south of this point is even more favorable to the production of cereals.

Game and wildfowl are scarce in Sakhalin, but its rivers teem with fish of all kinds, while, off the coasts, cod, salmon and herring abound. The codfish are nearly all sun dried and exported for food, but the bulk of the two latter are converted into manure for Japanese tea and paddy plantations, and fetch from £8

* From the Fortnightly Review.

* In Russian and French Prisons. By Prince Kropotkine. Ward & Downey, London.

* Of the 5,000 convicts at Korsakovsky-Post, only 1,500 are actually confined in prison.

† This road has now been carried on a distance of about twenty-five miles to Onor.

to £9 per ton. The largest and most important fishery on Sakhalin is owned by Mr. Denbigh, an old King's College man, who also trades extensively in seal and sable skins; but as fish manure is apparently, in his case, the most profitable article of commerce, the methods employed in catching and preparing the fish for exportation to Japan are perhaps worthy of notice.

At stated seasons of the year the herrings visit the coast in shoals for the purpose of depositing their roe, the first run usually occurring about the beginning of May, and being followed at intervals by others till the middle of June, when the fish disappear until the following spring.

A large trade is also done at Mauka in the long ribbonlike pieces of seaweed that, in the Gulf of Tartary, often cover the surface of the sea for miles. This is gathered, dried and shipped to China, where it fetches a good price and is considered a great delicacy.

Notwithstanding its climatic disadvantages, Sakhalin possesses so many resources that their development can only be a question of time. The Russians are a proverbially dilatory people; but there can be little doubt that the increase of population and enterprise, consequent upon the total abolition of Siberian exile, will within the next few years bring this lonely island, of which so few of us have even heard the name, into prominence and perhaps renown. Harry de Windt.

PORTABLE LUMINOUS PROJECTOR.

The curious property that platinum possesses of remaining incandescent for some time under the influence of hydrocarburets has long been known. This is an experiment that has been made in all courses of lectures since the time of Davy. It suffices to raise a fine platinum wire to a red heat, and then to place it over a saucer containing benzine, in order to have it remain incandescent. It is only within the last twenty years that advantage has been taken of this property in surgery, with the instruments devised by Dr. Paquelin and known as thermo-cauters. As long ago as 1857, M. Mathieu, at the suggestion of M. Masson, professor of physics at Louis-le Grand, constructed a surgical cauter based upon this principle; but it was not very successful, probably on account of defects in its manufacture. The wide use now made of the Paquelin apparatus proves that surgery has found therein a valuable auxiliary, and it is surprising that more of an endeavor was not formerly made to utilize those of Messrs. Masson and Mathieu.

In another order of ideas, Mr. Brenot, a skillful manufacturer of surgical instruments, who has for several years been constructing cauters of iridescent platinum, has recently utilized this same property of platinum for making illuminating apparatus. The idea was suggested to him by Dr. Mareschal, the principal surgeon of the army, who, in his Tonkin and Madagascar campaigns, often had occasion to regret the absence of an intense light in the arrangement of ambulances.

The idea of utilizing platinum kept incandescent under the influence of hydrocarburets for illumination is not new, since, in 1875, M. Lodi-Montaigne took out a patent on this subject, although his apparatus was no more successful than the Masson-Mathieu cauter, and probably for the same reason. It does not, in fact, suffice to start from a known principle; it is necessary also to seek a sure method of obtaining a maximum of the effect to be produced. In order to keep platinum incandescent for a long time and at will, it is necessary to fulfill certain conditions that have been particularly studied in the apparatus that are daily operated by surgeons. The hydrocarburet generally employed is what is called gasoline. By means of a blowing apparatus, there is set up a current of air and gasoline vapor which must be mixed in certain proportions in order to give the maximum effect. A special two-way cock permits, in the Brenot apparatus, of finding, after a few tentatives, the exact point at which the mixture is made under the best conditions.

The illuminating apparatus in itself is very simple. It consists of a small sphere of platinum gauze (Fig. 1, No. 1), of a size dependent upon the purpose for which the apparatus is intended, placed in the center of a metallic reflector. The handle that supports the whole is hollow and filled with a sponge saturated with gasoline. At its lower part there is a regulating cock which connects it with the blowing apparatus. The latter may be of variable form, but, as a general thing, there is employed a rubber bulb which is actuated either with the hand or with the foot, when, as in the projector designed to illuminate the larynx (Fig. 1, No. 2), the two hands are occupied. In the experiments recently made at Vincennes, there was employed with advantage air compressed in reservoirs carried upon the back and in which the supply of air was easily renewed by means of a small pump forming a part of the reservoir. These apparatus are found in the market, and are used for spraying grape vines. As the apparatus is not bulky, is very portable and is quickly set in operation, it is possible to produce an intense light at once in any place and in a determinate direction. With a projector having a reflector 0·24 m. in diameter, a surface of 40 square meters is illuminated at a distance of 200 meters, and the luminous intensity is sufficient to allow a person easily to read a newspaper at a distance of 100 meters. An illumination such as this will be a valuable aid in many military operations such as harnessing horses to batteries, lighting roads, engineering work, searching for wounded, urgent surgical operations, etc. From another view point in ordinary life also the Brenot projector will render many services, and we would especially mention the use of it for the search of malefactors and poachers (Fig. 2). It will perhaps be possible to apply it to the lighting of automobile carriages and bicycles.

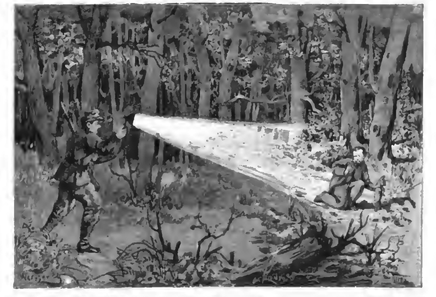


Fig. 2.—POACHER SURPRISED AT NIGHT BY MEANS OF THE PORTABLE PROJECTOR.

For the latter, the simplest arrangement would be to carry a reservoir of compressed air and keep the pressure up by pumping from time to time by hand. But for automobile carriages it would be very easy to arrange a pump that could at will be connected with the motor or even be set in operation automatically when the pressure of the reservoir reached a point regulated in advance.

These are projects that we propose to those whom it may interest, the inventor of the pump not having the time to study it himself.—La Nature.

Fig. 1.—BRENOT'S PORTABLE LUMINOUS PROJECTOR.

1. Illumination at a long distance. 2. Medical projector for laryngoscopy.

THE HALF TONE PROCESS POPULARLY EXPLAINED.*

By W. Gamble.

Having undertaken to popularly explain to you the half tone process, I ought, perhaps, in the first place, to make it clear to you what is meant by the term in its relation to process work. I have heard it stated that the process is called half tone because in the reproduction the picture is lowered to a half tone—that is to say, possessing neither high lights nor deep shadows. That explanation is, however, a mistake. The term "half tone" came about in this way. The difficulty of the early process workers was to find a satisfactory method of reproducing the half tones of the photograph in surfaces for mechanical printing. Taking the case of typographic blocks, it was easy to reproduce high lights by leaving the printing block hollow in those parts, so that they would not be covered with ink, and would deposit no color on white paper. It was also easy to reproduce shadows by leaving those parts in relief on the block so that the ink was deposited on them, and thus transferred a patch of solid color to white paper. But what would become of the half tones? It was not possible by the operation of passing a roller over the block to lay half a shade of ink on certain parts. Thus it was a picture without half tones, and therefore merely a silhouette. But these early process workers were led to reflect that the wood engraver got his tones by means of lines of more or less thickness, and by placing lines closer or further apart; also that the aquatint etcher obtained his effects by varying openness of a resinous grain, while the mezzotinter and the steel plate engraver obtained their effects by the closeness and size of the stippling; and, again, the lithographer took advantage of the grain of a coarsely ground stone. Thus it was argued that if the half tone of a photograph could be broken up into some sort of a grain, the problem of making the photograph into a printing block would be solved. We know that this problem was solved, after years of patient experiment, by placing in front of the sensitive plate a ruled screen—that is to say, a network composed of crossed lines on glass.

The photographic image was thereby broken up into a grain, which reproduced the tones of the photograph by dots of varying size. Half tone reproduction was, accordingly, achieved; and, naturally, the method was called the half tone process. I do not know who first called it "half tone," but probably it arose in this way:

It was variously called by different workers according to their fancy; for instance, it was the "Meisenbach" process, so called after the patentee of one of the methods, while others called it the "nature" process; and, besides, there arose such names as "heliotype" and "luxotype."

But the public wanted to know what these strange terms meant; hence it was usual to add "a process for reproducing the half tones of photographs," and this soon became shortened into "the half tone process." So this name, ugly as it is, has stuck to the business.

Now let us see how this half tone process is worked.

The first and most important requirement is a screen. This consists of two pieces of plate glass cemented together, and on the inner sides of these two plates are ruled parallel black lines, the lines on the one plate crossing those on the other so as to form a network. The most perfect screens are those made by Levy, of Philadelphia.

His method of manufacture consists in coating the glass with a ground which will resist a glass etching mordant, cutting the lines through the film by a diamond point driven by a dividing engine, and then etching the glass left bare. The resulting furrows are filled in with an opaque pigment, and the screen thus formed is very perfect in the two essential qualities of opacity and transparency. These screens are ruled in various degrees of fineness or coarseness, the ruling determining the size of the grain points. Thus for poster work fifty-five lines per inch are used. For newspaper blocks to suit rough and rapid printing seventy-five or eighty-five lines are used. Various styles of printing are accommodated with rulings between 100 to 175 lines to the inch. It is possible to get screens of 200 to 240 lines to the inch, but the blocks from these are a bit too fine for British printers. Most of the half tone work you see about in the magazines and illustrated papers is done with screens of about 120 to 150 lines to the inch. It is to be noted that the finer the screen used, the greater the amount of detail; the coarser the screen, the greater the amount of contrast.

The screen is placed in the camera immediately in front of the sensitive plate, but not in contact with it. In fact, provision must be made for securing a variable distance between the screen and sensitive plate, for

* Paper read before the Photographic Convention of Great Britain, at Yarmouth, July, 1897.

reasons which I will presently explain. In cameras made specially for half tone work there is in the back of the camera a screen carrier, which is made to travel to and fro by means of a lever or screw, and the distance at any point is shown by an indicator on the outside of the camera. When the dark slide is inserted and the shutter drawn, the screen carrier is brought forward as near to the plate as may be required. In the same way the screen may be brought up to the focusing screen until the right effect is observed, when the distance shown by the indicator is noted, and the screen can be set again to this distance when the dark slide is put in.

The old fashioned way of using the screen was in the dark slide, having two carriers—one for the plate remaining fixed and the other for the screen being separated to varying distances by means of strips of cardboard. It was a clumsy method, and I have here a newly invented slide in which there is a mechanical screen adjustment from the outside, and there is an indicator plate to show the distance. It forms a very compact arrangement, and its great merit is that it can be attached to any camera, so that if any of you want to dabble a bit in the half tone process you can fit up even a half plate camera with this slide.

The lens used for the process may be any good rapid rectilinear, but it must have a slot for Waterhouse diaphragms, not an iris, because it is necessary to vary the shape of the diaphragm openings. It is further necessary that the lens be fitted with a prism or mirror for reversing the negative, otherwise, as we print from the negative direct onto the block, we shall get a block which will yield an ultimate print the wrong way about.

The remaining fit up is pretty much in accordance with the ordinary arrangements for copying.

Having told you about the apparatus used, I must next explain to you the principles involved in the making of a half tone negative.

You want to know why it is necessary to place the screen at a certain distance, and how that distance is arrived at. Also why it is necessary to vary the shape of the diaphragm, and what is the shape required.

First, as to the screen distance. The early workers thought that the screen had merely a "chopping up" effect on the picture. The result of this want of knowledge was that the operator simply placed the screen close to the sensitive plate, and aimed at making it cast a sharp shadow of its lines on to the plate. The result was that the early half tone work had a raspy, gauze-like effect, which entirely killed all the delicate tone and detail of the picture, and even to this day some work has this characteristic as a result of the imperfect knowledge or perversity of the operator, who is much inclined to cling to obsolete methods of working. It was not till operators began to understand that the screen was an optical instrument, and not simply a sieve, that half tone work began to improve. Investigation into the theory of the screen working showed that under suitable conditions the screen might be regarded as a collection of tiny apertures which acted the part of pinhole lenses. It was just like the battery of "gem" lenses that you are familiar with for making postage stamp portraits, except that each aperture, instead of making a separate picture of the object, could only photograph the illuminated spot of light at the diaphragm opening.

Thus you will understand that there was a double action going on, viz., that while the picture was photographed through the screen by means of a lens, every aperture of the screen was doing a little business on its own account, namely, it was photographing the shape of the spot of light at the diaphragm opening. Of course, if the apertures of the screen were acting as pinhole lenses, they required a working focus; hence a screen distance was necessary.

Now, you will say, "We quite understand that this pinhole action may go on, but what is the use of it?" To explain it I must go forward a little to the printing process.

What we require in a half tone negative is a means of printing the picture on to the zinc or other metal plate in dots of varying size—big dots for black shadows, medium dots for half tones, and fine dots for high lights. Now if we are to print dots, we must have a negative, punctured, so to speak, with holes, but it is certain that if the lines of the screen were in contact with the plate we should not have a "perforated" negative, but the exact opposite, viz., a negative of separate dots, just as if you take a print from a piece of perforated zinc on to sensitive paper. But suppose you put the screen a little distance away and allow the pinhole action to form a larger dot, you can understand that it is possible to carry this spreading action until each dot touches and even overlaps its neighbor. Well, then, as the dots group themselves in spaces alternately, like the black squares of a chessboard, you will see that by making them spread until they touch, we get the "perforated" negative we require. In the old way, by assuming that the only object of the screen was to cast a shadow, the spreading of the dot had to be forced by long exposure and by vigorous intensification, which made the negatives hard and screeny, but by taking advantage of the pinhole action, the spreading is accomplished in a quick, harmonious and natural way. Another important advantage is gained. We find that the further the screen is from the sensitive plate, the less is its effect in breaking up the picture, and this also holds good to the extent that, if the screen is far enough away, the negative shows no screen effect at all; you would not know the screen had been there. Thus, you see that by taking advantage of the pinhole action, we can work our screen a considerable distance from the plate, and we get thereby more tone and detail. That explains the wide difference between the half tone work of to-day and that of even two or three years ago. The improvement is due to operators having found out, consciously or unconsciously, this little secret of the working of the screen.

The altering of the shape of the diaphragm had the same object in view, viz., the spreading of the dot in a suitable direction, so that we may get the "perforated" negative I have described. As the dot is formed by pinhole action, it is obvious we can make the dot any shape we please by altering the shape of the diaphragms. Thus we find that square dots give a better joining up to each other than round ones.

Once the operator has grasped these leading principles of the process, the negative making is an ordinary photographic operation, and either wet plates or dry plates may be used. There always has been a great prejudice in favor of wet plates, but for my own part, I find just as good, if not better, results can be obtained on suitable photo-mechanical dry plates.

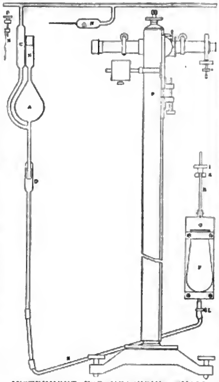
The negative made, it is printed on to a zinc or copper plate sensitized with a bichromated film, generally of albumen, gelatine, gum, or fish glue, the latter being now perhaps most extensively used.

The process is analogous to carbon, the film, after being exposed under the negative, being developed by washing away the parts which have been protected from the light.

The development is continued until the zinc is laid bare between the dots. Then the plate is dried, and in the case of fish glue, is heated until the glue is made so hard as to be acid resisting. Then the plate can be etched until the dots stand in sufficient relief to yield a printing surface. The remaining operations are only those of fitting it for the typographic printing press by trimming up and mounting it to the height of type.

Now I hope I have made plain to you what this half tone process is, and I want to plead with you to give it a little more tolerance. It is not yet perfect, but it is a young process and will improve. One so often hears tirades against it, and it is often said that "process" is antagonistic to the interests of the photographer on the one hand and the artist on the other. I do not believe any such thing. On the contrary, it has widened the scope of photography and opened a more extensive field for the artist. Where photography was only a method of producing portraits and views ten years or less ago, it now takes rank as one of the graphic arts. In this year we have been summing up on every hand the advantages we have gained from the prolific inventions of the present reign, but I think it has been overlooked how much has been done to three industries which have arisen out of the processes invented and brought to perfection in what has been called the Victorian age. I refer to electrotyping, stereotyping (by the papier maché process), and photo-engraving.

Take away these valuable auxiliaries of the printer, and we deprive at once the masses of the people of their cheap literature, whether it be in the form of books, newspapers or magazines. Pictorial knowledge is the most easily imparted, and has played a large part in the literature of this reign; indeed, we cannot measure how great a debt this age owes to photography and the photo-mechanical processes by reason of the wealth of illustrations which they have provided—not simply pictures that amuse, but illustrations which have made scientific, technical and general educational works far more valuable and instructive.



INSTRUMENT FOR MEASURING SMALL GASEOUS PRESSURES.

THE MEASUREMENT OF SMALL GASEOUS PRESSURES.*

By CHARLES F. BRUSH.

PRIOR to the invention of the McLeod vacuum gage, the measurement of even moderately small gaseous pressures was difficult, and subject to large errors. The introduction of the McLeod gage, however, early in the seventies, seemed to solve the problem. In its ordinary form, and for most purposes, this beautiful instrument admirably serves the purpose for which it is designed. But when very accurate measurements of pressures as small as a few millionths only of atmospheric pressure are desired, its performance is extremely unsatisfactory and vexatious. As is well known, the chief cause of the difficulty is the unequal and variable capillary depression of the two small columns of mercury, whose difference in height indirectly serves as the measure of pressure. Accurate measurement of this capricious difference obviously avails nothing.

Three or four years ago I was engaged in an investigation requiring frequent and simultaneous measurements of slight but different pressures in two large glass globes connected by a capillary tube. For this purpose I constructed and carefully calibrated two large McLeod gages. The internal diameter of the mercury tubes was about three millimeters, and they were made from contiguous parts of the same glass tube selected for uniformity of bore. These gages were often compared by measuring the same vacuum with both; but they rarely gave concordant results. Indeed, it was not uncommon at high exhaustions for one or the other of them to indicate a negative vacuum; that is to say, less than no pressure at all. The case of these two gages is cited because of the opportunity they afforded for comparison. In prior work I had, like most experimentalists, used but one gage; and while always suspicious of its indications, had no means of knowing how large its errors might be.

The phenomenon which I next desired to investigate is the spontaneous evolution of gas from glass and other surfaces in high vacua. For this purpose an accurate and entirely reliable means for measuring very small pressures was necessary, because I could not afford to wait months or years for the evolution of sufficient gas to be detected with certainty by the old gages. To meet these requirements I designed, constructed and learned how to use the modified form of McLeod gage which it is the purpose of this paper to discuss. It was deemed necessary to provide an apparatus capable of easy use, and giving results having a probable error not greater than a fiftieth part of a millionth of atmospheric pressure. My hopes of attaining this high ideal were far more than realized, as the sequel will show. Instead of having to wait days or weeks in the course of my investigations for the evolution of a measurable quantity of gas, as had been expected, the progress of evolution could be noted from hour to hour; and the increase in the rate of evolution due to a rise of one degree in the temperature of the laboratory was unmistakable.

The diagram herewith shows the essential parts of my apparatus. The bulb, A, of the gage, is made conical in its upper part, to avoid adhesion of gas bubbles when the mercury rises. This bulb holds about eleven pounds of mercury. B and C are the gage head and comparison tube respectively. They are nearly twenty millimeters inside diameter, and are made from contiguous parts of the same carefully selected tube. D is the usual air trap, and E is a long glass tube, with flexible pure rubber connections to the lower end of the gage stem and the mercury cistern, F. The latter is mounted on a carriage, G, which moves vertically on fixed guides. The height of the carriage is adjustable, at the upper end of its range of motion, by means of the screw, H, thumb nut, I, and forked support, K. The screw is pivoted to the carriage, so that it may swing out of the fork when the carriage is lowered. L is a pinch cock with screw, for regulating the flow of mercury, or stopping it altogether, while pumping out the trap, D. N is a bulb containing phosphorus pentoxide, to keep the interior of the gage and other parts of the apparatus perfectly dry. P is a very elaborate cathetometer for observing the mercury columns in B and C. This beautiful instrument has a revolving column with vertical scale, and vernier with microscope, reading to hundredths of a millimeter. The eyepiece micrometer reads directly to hundredths of a millimeter, and the divisions on the revolving head of the screw are so open that tenths of divisions are easily and certainly estimated by an experienced eye; thus permitting the micrometer to be read directly to thousandths of a millimeter. Of course the cathetometer is permanently located, not as shown, but with the objective of its telescope equally distant from the axes of the tubes, B and C, when it is alternately directed to them; and at such a distance that its micrometer readings correspond to a millimeter scale. The whole apparatus is located in a basement room, on a stone floor, whereby vibrations are reduced to a minimum.

The most important part of the gage is the head, B. The purpose of its great diameter is the reduction of capillary depression in its mercury column. But its size necessitates a very close approach of the mercury to its upper end, in order to sufficiently reduce its capacity. Yet the remaining space must be measurable by the cathetometer with the utmost precision. Hence the glass must not be distorted by heating, and the closed end just over the mercury must be sharply defined. In constructing this part of the apparatus, I selected a piece of heavy tubing which would just slip inside of B, with the least possible clearance. One end of this tube was closed as squarely as possible by fusion, and then ground with fine emery and a suitable tool to a convex spherical surface of long radius. Care was taken to make the center of curvature lie in the axis of the tube, and the ground surface was left unpolished to facilitate observation. A suitable length of the closed end of the tube was then cut off, slipped into B, and both tubes were fused together at their open ends as shown.

For calibrating the head, B, a ground glass stopper with a capillary duct was fitted to its neck, before the latter was sealed to the bulb, A. The head was then filled with mercury by boiling, thus completely filling the small space between its wall and the cap. After cooling, the stopper was inserted to expel all excess of mercury, and the whole weighed. Next the head was emptied and the mercury in the annular space distilled out. Again the head was very nearly filled with mercury, without allowing any to get into the annular space, and weighed as before; and the space between the top of the mercury and the convex end of the head was very carefully measured by the cathetometer. This process of weighing and measuring was repeated several times, with less mercury each time. Thus the capacity of a vertical millimeter of the head was ascertained, as well as the capacity that would remain, if the top of the meniscus of mercury just touched the convex end of the gage above it. Finally the neck was sealed to the bulb, A, and the capacity of head, neck and bulb combined was found by weighing them empty, and again filled with mercury.

For lighting the top of each mercury column, a narrow horizontal slit in an opaque screen, R, is used. The slit is covered with a strip of ground glass, and oblique-

* Read before the American Association for the Advancement of Science, August 28, 1897.

ly illuminated by an electric lamp. The screen and slit are vertically adjusted by a thumb screw, S. The heat of the lamp is prevented from reaching the mercury columns and head, B, by a thick screen. This is very necessary.

In order to get the best results from the apparatus many precautions are necessary. After filling A and B with mercury, time must be allowed for the compressed gas to cool. The effect of changing barometric pressure is nearly eliminated by so regulating the quantity of mercury in F that its surface is in the small tube at the bottom of the cistern when the gage is properly filled. Its area is then very small, as compared with that in B and C. The height of the menisens in both tubes is easily adjusted sensibly equal, by a little manipulation. I always raise the mercury above the point at which readings are to be taken, and then lower it, so as to read on a falling meniscus. This is highly important.

Some trouble was occasionally experienced at first from electrostatic induction between the mercury in B and the glass above it. This was shown by distortion of the meniscus when it was brought very near the glass. The difficulty was partially, but not wholly, remedied, by putting mercury in the outside open end of the gage head and connecting it by a flexible conductor with the mercury in the cistern, F. A complete remedy was effected by moistening the inside of the gage head with a dilute solution of phosphorus pentoxide. This became completely dried by the anhydrous phosphorus pentoxide in N, but was, of course, not dehydrated; and hence always remains conducting, and dissipates the static charge.

Large pressures, up to a thousand millionths or more, are readily measured with this apparatus, by finding with the cathetometer the distance between the mercury in B and the end of the head above it; from this is quickly calculated the necessary multiplier for the number of millimeters difference in height between the columns in B and C, also measured by the cathetometer, in order to express the result in millionths. For very small pressures, the micrometer wires are set at such a distance apart as to give a convenient constant (usually 2); and the column in B is adjusted this distance away from the glass; careful allowance being made for the thickness of the wires. Then the micrometer is used for repeated measurements of the difference in height of the mercury in B and C. The disturbing effect of bias is entirely eliminated by giving the micrometer screw a partial turn after each reading. Thus the next measurement is made without any knowledge of its difference from the preceding one, until the eye is removed from the telescope.

In my early experience with the apparatus, unusually careful measurements of very small pressures were often made, to determine how far its indications might be relied upon. In this connection I quote as follows from my notes, under date of February 20, 1895, concerning the last one of the series of pressure determinations: "Following is the last reading in detail, showing the extreme accuracy of these measurements:

	M.	M.	M.
	0·432	0·438	0·441
	0·441	0·4335	0·429
	0·4385	0·4275	0·4305
	0·426	0·450	0·445
	0·4335	0·4425	0·432
	0·4395	0·432	0·4185
	0·4305	0·435	0·435
	0·441	0·432	0·453
	0·435	0·4215	0·4425
	0·435	0·4245	0·438
Means...	0·4347	0·43365	0·43545

Mean of all the readings, 0·4346 M.

"Readjusted zero point of micrometer before each reading of each set. Partially emptied gage and readjusted capillary depression before each set of readings. The first series has no known source of error. The second and third series were made during wind squall, and surface of mercury was often tremulous. In the third series, capillary depression was perceptibly, though very slightly, unequal, in direction to make readings too high."

In the above quotation "M" means millionths of atmospheric pressure. The calculated probable error of the thirty readings taken together is only ninety-two hundredths of a unit in the third decimal place; that is to say, less than a thousandth part of a millionth of atmospheric pressure! The probable error of the three mean results, considered as single readings, is only eleven hundredths of a unit in the third decimal place of millionths. The net result may be expressed as follows, in terms of atmospheric pressure. Considered as thirty measurements:

0·000 000 434 60 ± 0·000 000 000 92.

Considered as three measurements:

0·000 000 434 60 ± 0·000 000 000 11.

Here we have the measurement of a total quantity of less than half a millionth of atmospheric pressure, with a probable error of only about a fifth of one per cent. of the quantity measured.

To show how small is the effect of variable capillary depression in the large mercury columns, the following measurements were made July 23, 1897. No correction was made of accidental capillary differences, but the columns were always observed with a falling meniscus. The zero of the micrometer was freshly adjusted for each reading; and before each of the six sets of readings the mercury was lowered, and then readjusted to the proper height in the gage head.

	M.	M.	M.	M.	M.	M.
	2·210	2·208	2·200	2·198	2·198	2·202
	0·204	0·195	0·202	0·203	0·204	0·198
	0·209	0·198	0·204	0·208	0·209	0·196
	0·203	0·204	0·210	0·209	0·196	0·208
	0·203	0·192	0·202	0·198	0·196	0·203
Means	2·2058	2·1984	2·2054	2·2014	2·1988	2·2014

Calculating the probable errors we have:

Six mean readings .... 2·20187 M. ± 0·00078 M.
All readings ... . 2·20187 " ± 0·00069 "

The effect of not equalizing the capillary depression is very apparent when these results are compared with the earlier ones quoted. But, on account of increased skillfulness of observation, due to long experience, the individual readings of each set are more uniform than before; so that the net result is better.

In this example we have the measurement of about two millionths of atmospheric pressure, with a probable error of only one part in three thousand of the quantity measured.

From the foregoing we may safely conclude that, with the apparatus described, small gaseous pressures may be easily measured, with a probable error of less than a thousandth part of a millionth of atmospheric pressure.

The smallness of this fraction is difficult to realize. It is comparable with a thousandth part of a milligramme in a thousand grammes; or a single kernel of wheat in two thousand bushels; or an inch and a half in the circumference of the earth; or the thickness of a sheet of tissue paper in sixteen miles.

RAREFIED AND CONDENSED AIR.*

AFTER reading Paul Guessfeldt's enthusiastic description of "mountain ecstasy," as he calls it, which the rarefied air of high altitudes produces and which he describes as consisting of "an increased sense of joy caused by an increased muscular activity, and a wonderful buoyancy of the feelings which at moments rises to ecstasy," we are tempted to follow him to those heights in order to experience these feelings which can be so easily obtained with a little physical exertion.

A different point of view is presented to us by D'Orbigny (1826) in an account of the sensations he experienced while crossing the highest pass of the Cordillera in Bolivia, which is 4,500 meters (about 15,600 ft.) high, on his way from the coast of Peru to La Paz. For several days before reaching the highest part respiration was difficult. His driver, the mule he was riding and his dog suffered so much that they were compelled to halt every 20 or 30 meters to regain their breath. While crossing the crest of the ridge he suffered intensely from pains in the temples, vertigo and extreme difficulty in breathing. Every movement of the body produced palpitation of the heart, followed by a feeling of general debility, until bleeding of the nose finally relieved him. During this attack of "mountain sickness" he saw two natives, who had overtaken him, hurry on their way, climbing the rocks with the greatest ease.

It is evident that D'Orbigny did not belong to an Alpine club, and did not have the necessary training, or else he would not have suffered so intensely at an altitude which has no effect upon those who now ascend Mont Blanc.

A man who has no practice in mountain climbing is apt to experience sensations similar to those which D'Orbigny described, while yet under the ordinary atmospheric pressure. For instance, in hurrying up a steep incline, say in the winter, when you sink into the snow with every step, you will very likely become short of breath, since the rapid climb prevents the full expansion of the lungs. This disturbs the circulation of the blood, which, being no longer freely admitted into the contracted lungs, collects in the veins. They swell up, the face becomes purple, the pulse beats are accelerated, and palpitation of the heart sets in. In case the exertion is continued, an attack of nausea is imminent, together with a feeling of faintness in the lower limbs, as the overworked muscles are deprived of their requisite supply of oxygen. A few long-drawn breaths usually suffice to remedy the disorder. By gradually becoming accustomed to walking and breathing slowly and regularly a further attack is prevented.

These symptoms, as they manifest themselves in the rarefied air of high altitudes, constitute what is known as mountain sickness, and persons unaccustomed to mountain climbing are frequently affected by it even while resting or when not exerting themselves. Here, again, the cause of the disorder is the insufficient expansion of the lungs, caused by the diminished atmospheric pressure, which renders respiration difficult.

But it may be objected that the energy with which we inhale the air is the same at high altitudes as below, and the rarefied air ought to penetrate into the lungs more easily. This is perhaps true, but, although we expand the chest during inhalation, the expansion of the lungs is only accomplished by means of the atmospheric pressure. The lungs are not attached to the inner surfaces of the thorax and can move freely. A wound in the thorax which admits the passage of air causes the lungs to contract, and all the exertions of the breathing apparatus will be powerless toward relieving this contraction.

As long, however, as the cavity of the chest remains closed and contains no air, the pressure of the air in the lungs acts from within outwardly, and by expanding the lungs will cause them to remain in contact with the sides of the chest as it expands during the process of inhalation. The ease with which the lungs are expanded depends upon the amount of atmospheric pressure which is brought to bear upon their elastic power of resistance, and this action consequently becomes more difficult as the lighter pressure of higher altitudes is reached. Let us suppose that the usual pressure is reduced to one-half, then the rapidity with which the lungs are expanded, although still greater than the usual rate of the chest expansion, is yet only half as rapid as when under the customary atmospheric pressure, and under certain circumstances this may seriously disturb inhalation.

Exhalation, on the contrary, is accelerated by the lighter pressure of a rarefied atmosphere. It generally takes place without the aid of the muscles which assist in the process of inhalation. The expanded parts, as the lungs, diaphragm, etc., contract to their original size and position by reason of their elasticity, as soon as the muscular force which was applied during inhalation is relaxed. The employment of the abdominal and intercostal muscles as an aid to exhalation is exceptional.

The only obstacle which retards the contraction of the lungs is the pressure of the outer air, which resists the outflow of the air from the windpipe and is diminished as the atmosphere becomes rarefied. Consequently the contraction of the lungs is greater and more rapid in a rarefied atmosphere. Exhalation is, therefore, in general, a mechanical process, and as such is subject to a certain law according to which it can be performed on the summit of Mont Blanc in $\frac{7}{8}$ of the time required under the ordinary atmospheric pressure.

Humboldt tells us that newcomers in the vicinity of Quito, Ecuador, where the altitude is between 2,600 and 3,600 meters (11,800 ft.), have considerable difficulty in breathing, especially when talking rapidly. This is explained by the fact that the supply of breath usually reserved for the formation of sound escapes more rapidly and is therefore sooner expended. It has also been observed that some persons are unable to whistle where the pressure has only been diminished from 760 mm. (ordinary atmospheric pressure) to 500 mm. The whistling sound is produced by placing the lips in a certain position, and depends upon the rapidity with which the air is forced out of the lungs by means of the abdominal muscles. Naturally, the amount of muscular force so expended is still suited to the requirements of the denser air to which one has been accustomed. As the atmospheric pressure is diminished, the air escapes more rapidly and the expected sound is not formed. In order to learn again how to whistle, it is necessary to place the lips in another position and to apply the muscular force differently, which always requires considerable time and practice.

Physicians who have made a short stay at Davos, which lies at an altitude of only 1,600 meters (5,200 ft.), state that during that time their respiration was much accelerated, while there was an inability to breathe deeply. The explanation of this phenomenon is the diminished atmospheric pressure, which also causes an acceleration of the pulse beats—the inevitable result of insufficient lung expansion. Accelerated breathing at high altitudes affects metabolism by aiding in the removal of gaseous excretions, such as carbon dioxide.

Aeronauts observe the acceleration of the pulse to be the first physiological change. They can reach a much higher altitude than mountain climbers without having any difficulty in sustaining respiration, as their muscular exertion is not so great. But the transition to the rarefied air is more sudden, and the increased difficulty in breathing, which now appears, although the aeronaut is generally unconscious of it at first, results from an insufficient expansion of the respiratory organs, which renders them incapable of admitting the requisite amount of rarefied oxygen. The strength of his respiratory muscles is diminished; he finally loses control of his limbs and his senses are dulled. This was the experience of Croce Spinelli, Sivel and Tissandier, who, on August 15, 1875, reached an altitude of 7,000 m. (23,730 ft.), with an atmospheric pressure of only 300 mm. in two hours. They followed Paul Bert's advice and inhaled oxygenated air, as a result of which their strength immediately revived.

After a long sojourn in regions of high altitude the symptoms of mountain sickness pass away, as respiration is gradually regulated to suit the conditions of the rarefied atmosphere. The change which this necessitates is easily explained. In order to breathe deeply it is necessary to expand the lungs more slowly, and this is only accomplished by means of continuous unconscious practice, which strengthens the respiratory muscles. The members of Alpine clubs who make high ascents keep in practice by repeating their excursions frequently. Hence they are far less subject to mountain sickness than those who have had no previous training.

The wonderful feats of Paul Guessfeldt, which are described in the German Rundschau of 1892, are a good illustration of the benefits to be derived from such a training. He breathed and moved without any inconvenience at an altitude of about 5,500 meters, where the atmospheric pressure is equal to only one-half of the ordinary pressure. In ascending Mount Aconcagua, in Chile, he had no difficulty in breathing until after the altitude of 6,000 meters had been reached, and even then he was finally able to ascend to the summit, which has an elevation of nearly 7,000 meters, or 23,910 ft., an altitude at which aeronauts are compelled to have recourse to their supply of oxygenated air.

A distinguishing characteristic of the air of high altitudes as compared with that of lower regions is its freedom from moisture. The atmosphere is so dry on the plateaus of the Andes in Peru and Bolivia, where the altitude ranges from 3,600 to 3,900 meters, that the flesh of butchered cattle can be dried in the open air. The two explorers D'Orbigny and Wedell both report that the sheep which are killed there are split open and salted, after which they are hung up in the open air and are dried in four or six days.

The ocean is the chief source of the moisture contained in the atmosphere; consequently, the interior of the continents is drier than the coast regions, and in the same way the moisture decreases as we rise above sea level. The lower stratum of air up to about 2,000 meters (6,500 ft.) contains one-half of the whole amount of aqueous vapor in the atmosphere, and here the cloud formations are densest and most frequent, while above this altitude the sky is much clearer.

It is a well-known fact that extreme dryness of the atmosphere stimulates the nervous system, making one feel brighter and more inclined for both physical and mental activity. The inhabitants of very dry regions, according to the reports of explorers, are free from any tendency to obesity.

In trying to escape from the hot air of the cities in the summer we look for a place which is situated higher above sea level, because we know it to be cooler. In the torrid zone, resorts with an elevation of from 2,000 to 3,000 meters are popular. In spite of being nearer to the sun, the air is cooler, as the sun's rays have practically no effect upon it. The air allows the rays to pass through it freely, but receives its warmth from the dark heat rays which are reflected from the earth after the sun has warmed it. The lower strata of air are, therefore, always warmer than the upper. But the plateaus of the highlands are cooler too, as well as the summits and crests, for their rarefied atmosphere is incapable of absorbing as much of the heat reflected by the earth as the denser atmosphere of the lowlands. Although the surface of the earth receives more heat at high elevations, it is immediately reflected back into space without heating the air to a corresponding degree. This is evidenced by the fact that at high altitudes the difference of the temperature in the sun and in the shade is greater than in the lowlands. But the effect of the sun's rays is felt more keenly at a

* From Science.

high elevation, so much so that persons staying at Davos can enjoy a sun bath in a sheltered spot even in the cold of winter, although wearing much thinner clothing than at home.

It takes a visitor at Cerro de Pasco, in Peru, which lies at an elevation of 4,300 meters, 10 or 12 days to thoroughly regulate his respiration to the conditions of the atmosphere. In case his suffering is greater at first, it often happens that he is compelled to make a temporary change of residence to a point some 1,000 meters nearer the level of the sea. Even during the descent he begins to breathe more easily and feels brighter and stronger.

The inhalation of air which has been artificially condensed, as in a pneumatic cabinet, produces quite similar sensations. An asthmatic patient placed in an atmosphere where the pressure has been augmented by nearly one-half will immediately be enabled to breathe more freely; respiration becomes slower; his excited nerves are quieted, and he feels imbued with renewed vigor.

The mechanical action of condensed air as it affects respiration is the reverse of the action which takes place in rarefied air. A higher atmospheric pressure facilitates the expansion of the lungs, and the condensed atmosphere, by delaying the egress of the air expelled during exhalation, finally effectuates a distended condition of the lungs. The pulse beats become slower at the same time, and the veins, which were surcharged with blood under a diminished pressure, are now emptied more thoroughly. This is the cause of the decrease of congestive conditions in a pneumatic cabinet. The amount of oxygen which we inhale is increased in proportion to the increased condensation of the atmosphere, thereby enriching the blood. If the treatment is continued, this soon makes itself manifest by an increased appetite and a healthier complexion. The invalid gains in strength and vitality. Respiration is facilitated even outside of the cabinet, and by such observations we perceive that the employment of condensed air has after effects, which supposition the spirometer confirms. A deeper and more quiet respiration has been observed in some cases after the elapse of one and even two years.

The air which is admitted into the pneumatic cabinets by means of air pumps can be kept at any degree of condensation. The cabinets, which are of various sizes, are arranged to admit from three to fourteen persons, and naturally great care is taken to have a good ventilation. They generally stand in the center of a lighted hall; their walls are composed of sheet iron and provided with windows which admit ample light for reading. The cabinets are used exclusively for the cure of catarrhal diseases, to facilitate the respiration of asthmatic patients and to improve the condition of the blood of anæmic persons, in which cases the condensed air frequently proves beneficial after all other remedies have failed.

The first pneumatic cabinet was established somewhere in the thirties at Montpellier by a physicist named Tabarie, who later gave the management of it into the hands of a physician. Pravaz soon followed his example at Lyons, and the reports of the two scientists as to their observations made on healthy and diseased persons were presented before the French Academy and to the medical world in quick succession. About thirty years later the idea of putting condensed air to this use spread from France to other countries of Europe, and the largest institution of this kind at present is at Reichenhall, the property of E. Mack, in which fifty-three persons can make use of the heightened pressure at the same time.

In 1841 M. Triger, a civil engineer, introduced in France the idea of using a heightened atmospheric pressure in building subaqueous works, and this gave an opportunity to observe what effect an atmospheric pressure which was much higher than that of a pneumatic cabinet would have upon the workmen. The work under pressure is carried on in an iron shaft, the sides and top of which are airtight. It is sunk to the bottom like a diving bell, while the upper end protrudes above the surface of the water. The fresh air which is continuously pumped in from above expels the water below, leaving the bottom free to be worked upon. The shaft sinks deeper and deeper as the earth is removed, until there may be a pressure of three and one-half or nearly four atmospheres. A pressure of ten meters of water is equal to about one atmospheric pressure.

The effect of the condensed air upon the laborers was found to be surprisingly favorable up to a pressure of two atmospheres. The hard work was accomplished more easily and with less fatigue than in the open air, and in such exertions as running up a ladder they did not get out of breath. Even after working hours the men felt stronger and in better spirits.

But when the pressure exceeds that of two atmospheres the men begin to have certain unpleasant sensations, such as itching and pains and swelling of those muscles which are strained the most. These symptoms do not, however, appear while under the heightened pressure, but make themselves felt during the time that the men are under the normal pressure, and pass away again as they return to their work. The overseers are exempt from these effects. They receive instead a mental stimulus which is manifested by an increased impulse to talk.

If the atmospheric pressure is still further increased, the resistance against exhalation becomes stronger. The action of the respiratory apparatus is weakened by the increased distension of the lungs until it finally becomes almost imperceptible; speech is difficult and whistling impossible. The result of the too rapid contraction of the lungs under a diminished pressure which prevents whistling is the same as that which follows when the egress of the air expelled by the lungs is delayed.

The enlivening influence on the workmen is diminished as soon as the pressure exceeds that of three atmospheres. The slow and imperfect performance of the respiratory function begins to have a detrimental effect upon the gaseous interchange which takes place in the lungs by causing the carbon dioxide to be retained in the blood. The laborers become more easily fatigued, and a decrease of appetite is followed by loss of flesh, if they continue the work. We find, therefore, that there is a limit to the condensation of air, which a man cannot overstep without detriment to himself, but there is a wider limit in this direction than in that of rarefied air.

Experience proves that a temporary change from the normal pressure to an increased or diminished pressure is pleasant and also benefits vitality in various ways. We are able to ascend to any altitude at which the air is rarefied to the desired degree, but the privilege of choosing a denser atmosphere in which to live is denied us. It is only from a few places at very high elevations that convalescents can be sent down to a lower altitude, where they quickly recover by inhaling air which is more condensed and contains a larger proportion of oxygen. The inhabitants of the lowlands are confined to the pneumatic cabinet in their search for these benefits. From what has been said regarding the mechanical change which respiration undergoes, we gather that a temporary employment of condensed air, besides its various other effects, would be a good preparation for the proper performance of the respiratory function in a more rarefied atmosphere.* G. VON LIEBIG.

University of Munich.

THE ZODIACAL LIGHT.

By Lieut.-Col. E. E. MARKWICK, F.R.A.S.

THE season when this phenomenon is visible after sunset is now approaching, and it may be interesting to take stock of what we know about it, which, after all, seems to be surprisingly little. It is generally dismissed in the text books with a pretty short notice, and sometimes is not mentioned at all. Although it can hardly be called a popular object in the sense that Mars or Jupiter is, still there must have been a great number of observations made of it at different times, and one looks for a corresponding definite advance in our knowledge of its interior economy. But the conditions of its visibility in our latitude render exact observation extremely difficult. Like the inferior planets, Mercury and Venus, it is seldom, if ever, seen more than three or four hours after sunset or before sunrise, and cannot be observed on the meridian. Again, its tenuous and ethereal character renders it a difficult matter to note definite particulars of its shape, size or position. In these respects no instrument is of the slightest service; but the observer should be one with a keen eye, which can take in a large area of the sky, and is quick in apprehending differences in brightness of particular areas. No telescope can do this, and, even with a binocular, the field of view commanded is far too small. The best way is to sweep the eye rapidly right and left, up and down—that wonderful faculty of "averted vision" assisting to note very faint degrees of light.

My own experience, based on some sixteen years of observation in different latitudes, is that, provided one has a clear country horizon remote from the glare of towns or electric lights, with a dark clear sky in January or February, there is no difficulty to the ordinary observer in England in detecting, soon after sunset, the pearly cone of the zodiacal light sloping upward from the sun's place. The boundaries are generally ill defined, and the apex has usually to be imagined more or less, so exceedingly delicate is the glow toward the extremity of the cone. Guillemin, in "The Heavens," has a very delicate plate of it, as seen in Japan. In this picture it looks fainter than it is sometimes seen in England.

For all practical purposes the axis coincides with the plane of the ecliptic.

An open horizon has a good deal to do with its visibility. For years I looked carefully for it in England without success, and I think the reason was that trees and other prominent objects, dark against the western sky, must have put my eye out of focus for the faint light. There are some who have not the power or capacity for this class of seeing, and I have before now, when in southern latitudes, pointed it out, quite blazing, to a friend, who, however, could make nothing of it, although it was literally staring him in the face.

Humboldt, in his "Cosmos," has some most interesting remarks on the subject, the more so as they are based on personal observation and considerable literary research.

My first observation of zodiacal light was in Natal, where it was at once palpable. It was in the dry, clear air of the uplands of South Africa, however, that it was seen to the greatest perfection; while in the Transvaal and in Bechuanaland the light was almost blazing—at least, it seemed so to an eye accustomed to astronomical phenomena, not to bonfires. Unless one has been in these circumstances of latitude and climate, it is impossible to imagine what an exquisitely delicate and ethereal object the light is. For there one has great advantages, notably in the transparency of the atmosphere, and the fact that the light is perpendicular, or nearly so, to the horizon. It is extremely difficult, when it slopes at the angle it does in England, to judge of the relative sharpness of the margins; a point which I have studied of late in connection with Dr. Veeder's theory of its duplicity. At Gibraltar, whence I write, it is often most beautifully seen as a whole, and Humboldt refers to its greater intensity in Spain, on the coast of Valencia, etc. From our coign of vantage we have the privilege of looking across the Bay of Gibraltar, with the range of hills beyond Algeciras in the distance, and, except for occasional shipping, this view is free from artificial illumination or glare.

Humboldt thinks that the zodiacal light was unknown to, or at least not mentioned by, the ancients. The word trabes, occurring in Pliny, which some consider means the phenomenon in question, refers to meteors, bolides, and comets. According to Humboldt, it is first explicitly described by Childrey, chaplain to Lord Henry Somerset, in his "Britannia Baconia."

Dom. Cassini was the first to investigate the phenomenon in its relations in space in 1683. Cassini, Humboldt says, maintained that a phenomenon observed by him at Bologna, also by Chardin in Persia, in 1668, was the zodiacal light, but that really this was the tail of the comet of 1668, whose head was at the time below the horizon. This calls to mind the great comet of 1882, which I first saw after perihelion in the beautiful sky of Natal about 4 A. M. The head was below the horizon and the tail sloped upward for many degrees—a most extraordinary vision. Never can that supremely beautiful sight be forgotten, as the comet majestically rose and displayed himself, surrounded by a gauze veil more ethereal than any bride's.

But no one could for a moment mistake the comet of 1882 for the zodiacal light. On the contrary, the view of the great comet of 1880, which I also got in Natal, might have been easily confounded with it, on account of its exceeding faintness and delicacy.

Humboldt considers that a remarkable light seen in 1509 for forty nights consecutively, in the elevated plains of Mexico, was the zodiacal light. He found a notice of this light in an ancient Aztec MS. preserved in the Royal Library of Paris.

Humboldt proceeds to inquire into the nature of the zodiacal light, and considers "a very compressed annulus of nebulous matter revolving freely in space, between the orbits of Venus and Mars, as the material cause" of it. Coming to more modern times, Sir J. Herschel thinks it is "that medium which resists the motion of comets, loaded, perhaps, with millions of tails of these bodies." Still later, the idea is that it consists of myriads of small meteors, each revolving round the sun in its own path, the light reflected from which impresses itself on our eyes as the zodiacal light. This is the opinion of Prof. Pickering, who, in vol. xix of "The Annals of Harvard College Observatory," has discussed many observations with his usual acumen.

It would seem certain from the observed angular distance of the apex from the sun that these meteors extend beyond the earth's orbit; and as the light lies in, or very close to, the ecliptic, we must be perpetually cutting through them as we revolve round the sun. Do we see in our atmosphere the falling meteors which have originally formed a portion of the zodiacal light? We are of the opinion this question can only be settled when that of the relation of comets to meteors is settled, and we know what a dubious matter that is in its purely physical aspect.

Dr. Veeder, of New York, considers that the zodiacal light "does not conform to the plane of the earth's orbit, but to that of the equator of the body which it surrounds, which in this case is the sun itself. As viewed from the earth, these coronal extensions are at times foreshortened, and at times opened out, so as to become more plainly visible. In the spring months, the south pole of the sun is inclined toward the earth, so that the latter is almost exactly in the heliocentric zenith of the southern sunspot belt and coronal extension. Consequently, the particles composing this extension are in a direct line between sun and earth, and, shining as they do by reflected light, like the new moon, they become almost invisible. Coincidently the coronal extension overlying the northern sunspot belt is opened out to its widest extent, and reflects more light earthward than at any other time. Hence, if these extensions become visible as the zodiacal light, the southern edge at this season should be the more sharply defined, and more exactly included within the plane of the ecliptic, because of the lack of illumination described; and the northern edge, on the other hand, should shade off very gradually, departing more widely from the plane of the ecliptic, and this is precisely what has been found to be the case."

My own observations made at Gibraltar most certainly support this view.* It has also been observed by Cassini and others. Dr. Veeder further observes that it is probable that "these coronal extensions serve as conductors of electrical impulses," and are therefore connected with the appearance of aurora.

The question of the variability of the zodiacal light has been much discussed. Humboldt says: "I have occasionally been astonished, in the tropical climates of South America, to observe the variable intensity of the zodiacal light. As I passed the nights, during many months, in the open air, on the shores of rivers and llanos, I enjoyed ample opportunities of carefully examining the phenomenon. When the zodiacal light had been most intense, I have observed that it would be perceptibly weakened for a few minutes, until it again suddenly shone forth in full brilliancy. In some few instances I have thought that I could perceive, not exactly a reddish coloration, nor the lower portion darkened in an arc-like form, nor even a scintillation—as Mairan affirms he has observed—but a kind of flickering and wavering of the light." These rapid apparent changes, however, he thinks, may be partly due to causes acting in the upper strata of our atmosphere.

Olbers convinced himself that "the light is very different in different years, often for several successive years being very bright and diffused, while in other years it is scarcely perceptible." This, of course, is a different sort of variation from the temporary or momentary changes just mentioned. Some modern observers think it decidedly variable in the way mentioned by Olbers—that is, more brilliant on some occasions than on others. But we must bear in mind two things in considering this question. First: as seen in England the total apparent length of the cone decreases gradually as the season of visibility goes on. Thus, for the evening apparition the length as observed in March and April is nearly always markedly less than when seen in January and February.† Hence, because the length of the cone appears different as seen at dates separated by an interval of (say) a fortnight, it is not necessarily to be inferred that the brilliancy has changed in that interval of time. Second: we all know how after a spell of dull or wet weather an unexpectedly clear night suddenly turns up. On the last occasion of a clear but "poor" night, the zodiacal light perhaps looked poor too. Now, on the very clear evening, it is seen under fine conditions, and naturally the finer and more delicate parts stand out clearly. But this is not variability. We cannot focus our sight on to this delicate object as on a variable star, and the circumstances are such as do not admit of the application of exact photometry to the case. To decide this question we need a regular series of systematic observations made in some clear and serene sky, like that of Peru or the Transvaal, night after night and year after year. Such observations should give, according to a fixed method, the length and breadth; also the brightness, say at certain fixed altitudes, as compared with the Milky Way. It is only from such a record that the question of variability can be settled. Very possibly, changes

* Translated from the author's MS. by Henrietta Weber, Columbus, O.

* See English Mechanic, No. 1625.

† See observations of Prof. Pereira and self in Journal Brit. Ast. Assoc., vol. v, pp. 381, 421.

in the density of different parts of the zodiacal meteors or cosmic dust may take place from time to time, and, consequently, changes in brightness. But I do not think that so far they have been fairly proved.

Some observers have noted a ruddy tint, but I confess that I have never detected this.

Good observers, like Admiral Smyth, acknowledge many disappointments of not catching it; and to anyone who has not yet seen the light, but wishes to do so, I would offer the following suggestions: Time, middle of January to middle of March; locality, remote from any large town or collections of lights. From some of the breezy commons and downs of Surrey or Sussex, well to the south of the metropolis and free from trees, one can command a grand sweep of sky. Better still if the observer has a sea horizon to the west, for then, provided there is no shipping, he may be absolutely certain that no artificial glare exists. Choose a brilliant evening, such as sometimes comes after heavy rain. There must be no trace whatever of moonlight, which blots out our faint subject. Keep on the lookout, say, from a quarter of an hour after sunset. Do not strain the sight by looking fixedly at a star or in one place. Cast the eye occasionally over the western sky toward the horizon, and with the above circumstances favorable, you should have no difficulty in "catching" the phenomenon and "holding" it, too. I am not quite prepared to say whether nearsighted persons would be handicapped in this search. Possibly spectacles may in some way impede vision in sweeping over a large area of the sky. There must be a slight loss of light, even through one lens only. Personally, I am blessed at present with a long sight, which does not need any assistance in the way of glasses. When once seen, it is comparatively easy to see it again another night, as we then know what sort of a thing it is we are looking for.

It is curious that the zodiacal light has not been seen during a total eclipse of the sun, and it would therefore seem that its light is decidedly inferior to that of the corona. At the same time, in such a consideration one must not omit to take account of the vast area of illuminated earth and sky which surrounds the moon's shadow cone. The darkness of an eclipse is not that of night.

Would an observer from Neptune, supposing he could do without any atmosphere himself, see the sun as a "nebulous star," with the zodiacal light extending on either side like a delicate comet? Very probably—with many a comet plowing through it, which our own atmospheric veil prevents us by its brilliant glare from seeing. Take as an instance the comet seen close against the sun during the total solar eclipse visible in Egypt in 1882.

There are two other phenomena connected with the zodiacal light, viz., the gegenschein, or counter glow, and the zodiacal band. The first is a faint patch of light seen very nearly opposite the sun's place; the other is a prolongation of the zodiacal light to the gegenschein. Both these are excessively delicate phenomena and require the finest sight and sky. Although I consider I have a good eye, I have never seen either. Even Prof. Pickering can only say that "the evidence for the actual existence of some light opposite the sun becomes tolerably strong." Still, there can be but little doubt of the existence of the gegenschein from the observations of Brorsen, Schmidt, Heis, Backhouse, Lewis, Barnard and others. But the ordinary observer can hardly hope to detect this or the zodiacal band. —Knowledge.

FISHING DURING THE TRIP OF A MERCHANTMAN.

A SLIGHT breeze is blowing. With all its sails set, a three-masted merchantman is plowing its way through the blue waters of the Atlantic. Astern, upon the poop, some of the crew are at work making foot ropes fast to a new mainsail. The captain is striding the deck, casting a glance at the sails, at the steersman and at the sea, and punctuating his promenade with orders: "Keep your eye on the helm!" says he to the steersman. "Tauten the sails there!" exclaims he to the sailors. But see yonder, in the distance, those black objects that are leaping upon the sea and marking their passage with a streak of foam! "Aha! they are porpoises! Boatswain, get out your harpoon, quick! And the rest of you there, come to the forecastle!" At the captain's exclamation every one raises his head, the cook comes out of his galley, the cabin boy leaves his table utensils in confusion, and all run to the forecastle. The harpoon is provided with its line and handed to Loic, the most expert of the crew in this sort of fishing. Loic climbs down beneath the bowsprit, and here, his feet firmly planted upon the backstays, his left hand grasping the martingale, and his right brandishing the harpoon, he waits.

PORPOISE FISHING.

In the distance, the porpoises tack about and point their noses toward the ship, and then, turning in the opposite direction, put the patience of the fishermen to a severe test. Loic whistles in order to attract them. Finally, three of them separate themselves from the group and come direct for the ship, to which they are attracted by its copper shining in the sun.

"Attention, Loic! there they are!" and the three cetaceans pass by as quick as a flash in leaping at a couple of yards from the vessel's stem. Loic's uplifted arm shoots forward like a released spring, and one of the porpoises, pierced through and through by the harpoon, struggles at the end of the line and makes desperate efforts to escape in tinging the blue water of the sea with its blood. "There he is!" cries Loic in regaining the forecastle.

The animal is allowed to struggle and exhaust itself for a moment, and is then gently hauled up alongside, where a line with a slip noose is made fast to its tail, so that it may be lifted on board by means of a capstan. From the forecastle it is sent to the deck, where the harpoon is removed, and it becomes the temporary property of the cook. Under his expert hand, the porpoise is converted into savory steaks and into huge meat pies that will somewhat vary the mess of pork and beans and hardtack and salt mackerel that forms the basis of the food of the crew of merchantmen.

Shark Fishing.—A shark has been following the ship for a couple of days, awaiting some windfall or other, perhaps the fall of a man from a mast. Its proximity is annoying, and, although the catch is not worth much, an endeavor is to be made to capture it. At the captain's order, the boatswain goes to get a huge hook provided with a chain six feet in length used for this sort of fishing. A rope is attached to this, and the hook having been baited with pork, the whole is trailed astern. Master Shark is always on hand, disporting in the blue water, swimming around the ship, passing under the keel, sometimes disappearing for an hour or more, and then betraying his presence by his fin. On board, he is being watched, in order to see if he will notice the bait. Finally, the odor of the pork attracts him. He pounces upon it, rubs his nose against it in order to ascertain the nature of the thing, turns about suspiciously, makes a point seaward, then suddenly returns, and, his resolution having been taken, turns upon his side, opens his jaws and swallows the bait. Then the hook operates, and the shark begins his dance. His formidable bounds make the stern of the ship tremble amid splashes of foam. The line is paid out a little, and then, when the motions of the shark become slower, the ship proceeds smoothly. Now that he is taken, and well taken, there is nothing to be done but tow him along for a few hours, and with the eight knots that the vessel is making he will soon be mastered.

The next morning, before washing, the captain comes to take a glance. "He can be hauled in now; the old fellow is half dead. Pull in the line to see!" says he. The line is pulled in, and the shark no longer gives any sign of life. It is the moment to take him on board. The brigantine is brailed up and the sheets of the main boom are secured. A winding tackle coming from the mizzen mast is attached to a strong ring of cordage surrounding the main boom, and to the latter is hooked a pulley block through which the line is passed. Then all hands begin to haul, and the shark comes under the taffrail. "Hoist away, my hearties!" The head now comes out of the water, and gradually the body makes its appearance. Sometimes the shark seems to take a new lease of life, and lashes the water with furious blows of his tail. In such a case, he is submerged again. Master Shark this time does not budge. A strong slip noose is passed under the caudal fins, the main boom is braced leeward, and the end of the line is hauled by hand, and guided by pulleys to the capstan upon the forecastle. Then all hands heave at the capstan until the shark is hauled up and laid upon the poop. From there it is dragged to the deck.

There is often a terrible awakening. Then, beware of the blows of the tail and especially of the snapping of the teeth. The animal struggles in opening and closing its formidable jaws with a sharp click, while its tail pounds the deck planks. The men, armed with axes, then attack it and aim especially at the head and tail. Finally, cut and slashed, the shark no longer budges. A few slices of its coriaceous and oily flesh are set aside for the crew, while the captain reserves for himself the vertebral column, which, once arranged and a ramrod inserted in the interior, will serve as a cane, and, at all events, as a trophy. As for the remains, these, thrown overboard, will regale the bonitas and other fishes.

Capture of Albatrosses.—The capture of the albatross, like that of the shark, is, upon the whole, merely a pastime, its oily flesh, smelling like fish, not proving a very agreeable and delicate food. The albatross furnishes the pipes and tobacco pouches of merchantmen sailors. It is also a sort of certificate of the passage of the Cape.

The process of capturing the bird is as follows: To the end of a strong line is fastened a hook of the size of those used in trailing for tunny. This hook is carefully concealed in a piece of thin canvas cut into the form of a fish, or is baited with some sort of detritus or other, and the whole is thrown into the sea. The albatross, which is voracious by nature, never fails, whenever it

sees the bait, to pounce upon it. As soon as it finds the hook fastened in its bill, it spreads its wings and flies away in endeavoring to free itself by violent struggles. If other albatrosses or frigate birds chance to be in its vicinity, they take flight with strident cries in describing circles around the prisoner and in seeming to seek a method of delivering him. A slight pull is given upon the line, and, when the bird is of large size, two men are none too many for the work of landing it upon the deck of the vessel. Once on board, it only remains to kill it. Some put it to death by thrusting a strong sail needle into its skull—a cruel process that has the drawback of not being followed by an immediate result. Others strike it upon the neck with a club. The albatross is not a very handsome bird, and it is remarkable only by the huge size of its wings, the spread of which sometimes reaches twelve and even fourteen feet in adult individuals.—L'Illustration.

SHARK FISHING.

CAPTURE OF AN ALBATROSS.

DREAMS.*

At the psychological congress last year, Dr. J. Mourly Vold, of Christiania, reported some experiments which he had undertaken with regard to the artificial stimulation of visual elements in dreams. The subjects included a large number of persons of different ages, sexes and classes, but were mostly adults of an intellectual type above the average; all those selected were good dreamers. Dr. Vold arranged the experiments as follows: To each of his subjects he sent, from time to time, a package containing figures of animals, well-known objects, etc., cut out of white paper, or some striking colored object—a flower, coin, etc. The package was only opened after the subject was in bed. The contents were then displayed on a black background, and scrutinized closely for a considerable time—usually from two to ten minutes—without intermission; in some cases for half an hour or more, interspersed with periods of rest. The light was then put out, and the eyes closed. In the morning, immediately on awaking, the subject wrote a report of his dreams, together with the conditions of fatigue the night before, length of sleep, etc. Prof. Vold supplemented these reports, when it seemed desirable, by verbal questionings. Some three hundred separate tests of this nature were made.

On examining the results, it was found that the character of the dreams depended on a number of distinct factors, such as the quietness and uneventfulness of the preceding evening, but that it did not depend (so far as could be discovered) on the specific time of experimentation or of awakening, nor on the obtaining of after-images from the given objects. The size, form and color of the objects were rarely all reproduced together, but one or two of these conditions often reappeared in the dreams. The form and size of the object were frequently reproduced, either as in the original or with some modification; this transformation often occurred in the dream itself. The color exerted an influence independent of the other factors, and this proved the point of greatest interest in the results. When the given objects were black or white (with complementary background) the dreams in many instances exhibited recurring contrasts of light and shade. Often the object reappeared (with considerable change of form) in the same color as shown; or some other object appeared in the given color, which might be a very unusual one for it to take; in this case, either the color of the background reappeared also, or no background was discerned. In experiments with colors other than black and white, the given color also tended to reappear; this was especially the case with red; the color might recur in the same tone, saturation and brightness as in the given object, or it might appear modified in these respects; or, such a modification might take place in the course of the dream, as in the case of modifications of form.

The author concludes from these experiments that the visual apparatus immediately before awakening reproduces to a certain extent the condition present at the time of falling asleep; but that the original associations of form, size, color and abstract representation are broken up, and new syntheses constructed in their stead. In these new syntheses the common visual forms, or abstract representations of daily life, are apt to become associated with the colors or outlines of objects which affect the organ of vision just before the beginning of sleep. Some such theory seems necessary to account for the facts brought out in these experiments.

In a note in the Revue Philosophique, M. E. Goblot speaks of the connection between dreams and the act of awakening. He urges the view that dreams which we remember are those which accompany the latter state. The passage from sleep to wakefulness, like that from wakefulness to sleep, is not an instantaneous process; it occupies at least an appreciable time. The dreams which we are able to remember afterward are those that belong to this period of transition; and this fact, the author insists, is more than a mere coincidence. When we analyze a remembered dream, we find in its last stages always some elements of external sensation, which gradually (or quickly) unfold into the conditions of normal waking life. All the organs of sense and movement do not wake at the same time; and to this is due the transition period just mentioned. It is only the dreams of this period—in which some of the conscious elements are those of sleep, while others belong to waking life—that we are able to connect through memory with after-consciousness; and the memory connection is due to precisely this association of elements of waking consciousness with the dream elements. This is the reason, says M. Goblot, why we do not remember those dreams occurring early in the night, in which we talk, cry out, gesticulate, or walk, though such dreams can scarcely fail to have been most vivid; for, unless they result in our awakening, there is no associative element in waking consciousness capable of recalling them. Even those dreams which we do recall have usually so slender an associative element that they are speedily forgotten, unless we take special pains to impress them upon the memory by writing them down or rehearsing them soon after waking.

The present writer would suggest that more attention be paid, in the study of dreams, to determining the normal visualizing power of the individual. It is well known that some persons habitually "visualize" their visual memories (i. e., represent them in the form and color of the original); while others, including those more accustomed to abstract thinking, are lacking in this power, and substitute words or other symbolism for the visual picture. The same is true to some extent of sounds and other classes of sense memories. In sleep, where outer stimulation is practically wanting, central images play the chief rôle, and in the absence from consciousness of more vivid presentations are mistaken by the subject for primary sense impressions. It would seem, then, that there ought to be a broad distinction of some sort between the dreams of the visualizing and symbolizing types of individuals. Whether good visualizers are better dreamers, or whether their dreams are merely of a different character from those of symbolizers, remains to be seen. But certainly the question is well worth investigating. So far as I know, no attempt has yet been made to gather data bearing on this point.

* The American Naturalist.

SOLUTION FOR PREPARING COLOR SENSITIVE PLATES.

H. Vollenbruch, in Deutsche Photographen Zeitung, maintains that plates sensitized with erythrosin silver citrate are not only more sensitive to color impressions, but also have better keeping qualities than ordinary erythrosin bathed plates.

For depression of the over-active blue rays he recommends the addition of picric acid to the coloring solution. The picric acid erythrosin silver citrate ammonia solution is prepared as follows:

Solution I.

Citrate of potassa	1 grm.
Distilled water	10 c. c.

Solution II.

Silver nitrate	1 gr.
Distilled water	10 c. c.

Both solutions are mixed and a white precipitate is formed which is allowed to subside. The clear supernatant liquid is poured off carefully, precipitate washed with water, allowed again to subside, and the wash water again decanted. This process is repeated two or three times. Finally a large bulk of water (30 cc.m.) is

added to the precipitate and well shaken; 5 c. c. of this is reserved, the remainder is treated to ammonia, drop by drop, until the precipitate is redissolved. Now add the 5 c. c. of reserved solution and shake the whole until every particle is dissolved. Then make up the solution to 50 c. c. and filter; this forms Solution III.

Solution IV.

Distilled water	300 c.c.
Pure erythrosin	1 gr.

Under lamp light the 50 cc.m. of Solution III. are poured slowly with repeated shaking in Solution IV, by which the originally beautiful red is converted into a dirty turbid bluish red somewhat viscid fluid; add—

Solution V.

Picric acid	4 grms.
Absolute alcohol	30 cc.m.

Shake well and add to the whole 33 cc.m. ammonia (specific gravity 0·91), wherewith the beautiful red color is restored.

After the filtration call this Solution VI. This solution keeps well. The slight deposit formed is redissolved on shaking.

The plates are sensitized as follows: The plate to be sensitized is first laid in a tray of distilled water for two or three minutes, then bathed in a mixture of 1 c.c. ammonia for one minute and finally for two minutes in a bath composed of the following:

Color Solution VI	10 cc.m.
Distilled water	300 cc.m.

The plate is well drained and dried in a perfectly dark room. These plates keep well for several months.—American Journal of Photography.

THE PRINTING-OUT PLATINOTYPE PROCESS.

THE statement made by Mr. Cembrano in his presidential speech before the convention at Yarmouth, England, to the effect that "a paper is much needed possessing the ease and simplicity of manipulation, permanency of results and beauty in quality of platinotype, combined with the certainty in printing of what are commonly called printing-out papers," naturally suggests to one the printing-out platinotype process, which seems to have been much neglected in England.

This process was suggested by Pizzighelli in 1887, and differs from the other platinotype processes in that the developer is in the sensitizing solution. As a rule, sodium ferric oxalate is used, which, by exposure to light, is reduced to sodium ferrous oxalate and sodium oxalate, according to the equation:

$$Na_6 Fe_2 (C_2 O_4)_6 = Na_4 Fe_2 (C_2 O_4)_4 + 2 Na_2 C_2 O_4 + 2 CO_2.$$

Sodium ferric oxalate occurs in fairly large green crystals, which are perfectly stable in the dark, and are easily soluble in water (about one in two), and when spread on paper it gives a yellowish green film.

As damp is necessary for the full development of the image, it is necessary to expose it to aqueous vapor before printing; otherwise the printing is precisely the same as for any other of the platinotype papers. The best way of dampening the paper is to fill a developing dish with warm water, and just hold the paper for about three minutes in summer and one and a half minutes in winter, film face downward over the same. It is frequently recommended to breathe on the paper while it is in the printing frame; but this is hardly to be commended, for the simple reason that part of the paper near the middle of the frame, as a rule, gets less moisture, and therefore shows fainter in the finished print; further than that, the negative, unless covered with a piece of plain paper, also becomes moist and absorbs some of the platinum or iron salts, and thus stains are caused which are extremely difficult to eradicate.

For this process there is no doubt that Rives or Saxe papers are the best, though Whatman's or Creswick papers may be used.

The sensitizing salts should be made up into the form of stock solutions. The sodium ferric oxalate solution should be made by dissolving, by the aid of a gentle heat, 240 grains in 1 ounce of distilled water, and the solution filtered and labeled "The Iron Solution."

The chloro-platinite of potash may be dissolved in the proportion of 1:6, or a 15 grain tube in 90 minims of distilled water.

Besides these will be required a ten per cent. solution of sodio-chloride of platinum, which is added to the sensitizing solution to give brilliancy or greater contrast, and is especially useful for thin, flat negatives.

A solution of gum arabic must also be used, and 1 ounce of the best white gum arabic in lumps should be dissolved by constant stirring in 2 ounces of distilled water, and then filtered through nainsook, using pressure if necessary.

The sensitizing solution itself is prepared by mixing, preferably in a flat dish or saucer:

Chloro-platinite solution	116	minims
Iron solution	120	"
Gum arabic	116	"

The above quantity is sufficient for 480 square inches of paper. The solution should be brushed over the paper with a broad, flat brush, not too soft, and then the marks evened out with another till it has lost all glaze, then quickly dried, and the process of drying should not take more than half an hour. Great care should be exercised in the choice of the brushes. A soft camel's hair brush will mop up too much solution, while a hard brush is apt to cause marks in the sensitizing.

Sepia-toned pictures may be obtained by the addition of palladium or mercury salts to the sensitizers, but the results obtained by these are by no means satisfactory, nor is there any good method of obtaining sepia tones direct by this process.

Mercury gives, as a rule, yellowish whites, and the tones are not even, that is to say, the high lights may be sepia, the half-tones gray, and the shadows black. With palladium the difficulty is to keep the paper, and it must be printed out dry and then developed, or else variations in tone and general reduction may ensue.

A formula strongly recommended by Watzek for the mercurial paper is:

Sodium ferric oxalate solution	168	minims
Potassium chloro-platinite solution	100	"
Potassium chlorate solution	4	drops
Mercuric chloride solution	84	minims

All these solutions should be saturated. It will be found necessary, if this be used, to give the raw paper at least two coatings of plain two per cent. arrowroot size; but it is preferable to use the gum arabic solution in about the same proportion as suggested for the black paper, and also to replace the chlorate of potassa by a like quantity of sodio-chloride of platinum, which keeps the white purer.

For the palladium paper the following may be used:

Iron solution	120	minims
Chloro-platinite solution	80	"
Potassio-chloride of palladium solution (1:8)	20	"
Gum arabic solution	116	"

It must not be forgotten that this paper must be absolutely dry during printing, and only developed by steam afterward.

The subsequent treatment of these prints is precisely the same as for ordinary platinotype, namely, the use of the three acid clearing baths, and then well washing. The process is not a difficult one. The chief difficulty is the drying.—British Journal of Photography.

DELICACY OF VARIOUS REACTIONS FOR METALS.*

By Dr. B. NEUMANN.

THE following table, in its rearranged and improved form, is the result of the author's personal experience and comparison with well known authorities:

Metal.	Reagent.	Sensitiveness.
Arsenic (as arsenious acid)	Hydrogen Sulphide	1:3,600,000
	Sodium Sulphite and Stannous Chloride	1:20,000
	Sodium Thiosulphate and Hydrochloric Acid	1:1400
	Lime Water	1:4000
	Cupric Sulphate	1:8640
	Argentic Nitrate	1:200,000
	Electrolysis	1:1500
	Electrolysis (with Fe and Cu)	1:133,000
	Marsh's Test (Mohr)	1:500,000
	Marsh's Test (Devergie, Otto)	1:100,000
	Bettendorf's Test	1:1,000,000
	Fleitmann's	1:5000
	Gutzeit's	1:1,000,000
	Reinsch's	1:250,000
	Fresenius-Babo	1:5000
	Zwenger's	1:50,000
Antimony	Zinc (Fresenius)	1:30,000
	Zinc (Rideal)	1:20,000
	Hydrogen Sulphide (Rideal)	1:41,000
	Hydrogen Sulphide (Neumann)	1:100,000
	Lime Water	1:1200
	Potassium Carbonate	1:2000
	Electrolysis	1:1,500,000
	Electrolysis (by Fe and Pt)	1:80,000
Bismuth	Potassium Iodide (Stone)	1:4,000,000
	Potassium Iodide (Field)	1:1,000,000
	Hydrogen Dioxide	1:100,000
	Tartaric Acid and Stannous Chloride in K O H Solution	1:210,000
	Potassium Cinchonylhydroiodide	1:1,000,000
Cadmium	Sodium Sulphide	1:250,000
	Potassium Ferrocyanide	1:10,000
	Sodium Hydrate	1:50,000
	Sodium Carbonate	1:20,000
Cobalt	Potassium Ferrocyanide	1:60,000
	Potassium Cyanide and Ammonic Sulphide	1:50,000
	Sodium Sulphocyanate	1:3000
	Potassium Xanthogenate	1:100,000
	Ammonia	1:1,000,000
	Sodium Hydrate	1:10,000
Copper	Potassium Ferrocyanide (Wagner)	1:200,000
	Potassium Ferrocyanide (Cooper)	1:4,000,000 1:11,750,000
	Potassium Ferrocyanide (Neumann)	1:250,000
	Ammonia (Wagner)	1:25,000
	Ammonia (Neumann)	1:50,000
	Ammonia (Will)	1:100,000
	Ammonia (Cooper)	1:1,000,000
	Potassium Xanthogenate (Wagner)	1:200,000
	Potassium Xanthogenate (Schwarz)	1:1,000,000
	Hydrogen Sulphide (Cooper)	1:15,000,000 1:4,150,000
	Hydrogen Sulphide (Neumann)	1:300,000
	Potassium Arsenite	1:10,000
	Sodium Sulphide	1:700,000
	Sodium Hydrate	1:30,000
	Potassium Carbonate	1:14,000
	Hydrobromic Acid (Neumann)	1:10,000
	Hydrobromic Acid (Sabatier)	1:10,000,000
	Hydrobromic Acid (Endemann and Prochazka)	1:100,000
	Sodium Sulphite and Pyrogallol	1:3,000,000
	Electrolysis (with Iron)	1:15,000
	Electrolysis (with Pt and Zn)	1:4000
	Electrolysis (with Pt and Br)	1:1,000,000
	Guaiac Tincture and Alkali Chloride	1:10,000
	Guaiac Tincture+HCN	1:500,000
	Guaiac Tincture Alcohol+HCN	1:10,000,000
Ferric Oxide	Potassium Ferrocyanide	1:500,000
	Potassium Sulphocyanate	1:1,600,000
	Ammonia	1:800,000
	Ammonia and Thioglycolic Acid	1:200,000
Ferric Oxide	Extract Logwood	1:15,000,000
	Tannic Acid	1:200,000
	Salicylic Acid (Smith)	1:32,000
	Salicylic Acid (Almén)	1:100,000
	Ammonium Sulphide	1:2000
	Sodium Sulphide	1:700,000
Ferrous Oxide	Potassium Ferrocyanide	1:440,000
	Ammonia	1:500,000
	Oxalic Acid	1:5000
	Sulphuric and Nitric Acids	1:300,000
	Tannic Acid	1:440,000
	Sodium Sulphide	1:700,000
Gold	HCl+Stannous Chloride	1:100,000,000
	Aqueous Hydrogen Phosphide	1:10,000
	Potassium Sulphocyanate	1:10,000
	Stannous Chloride (on Gold Bromide)	1:1,433,000
Iridium	Concentrated H_2SO_4+K OH	1:1,000,000
	Concentrated H_2SO_4+K OH, and Ammon. Nitrate	1:1,000,000
Lead	Hydrogen Sulphide (Pappenheim)	1:100,000
	Potassium Bichromate	
	Hydrogen Sulphide (Cooper)	1:100,000,000 1:196,000,000
	Potassium Bichromate (Cooper)	1:4,000,000
	Potassium Bichromate (Harvey)	1:3,500,000
	Sulphuric Acid	1:40,000
	Sodium Sulphate	1:5000
	Potassium Carbonate	1:30,000
	Potassium Ferrocyanide	1:18,000
	Potassium Iodide (Jeannel)	1:40,000
	Potassium Iodide (Neumann)	1:10,000
	Electrolysis	1:50,000
	Cochineal Solution	1:400,000
	Electrolysis+Cl+HI or H_2S	1:130,000
Magnesium	Ammonia	1:9000
	Ammonia and H_3PO_4	1:200,000
Manganese	Silver Nitrate and Caustic Soda Solution	1:200,000
	Potassium Ferrocyanide	1:25,000
	Ammonia	1:100,000
	Sodium Sulphide	1:500,000
Mercuric Oxide	Potassium Iodide	1:8000
	Hydrogen Sulphide (Schneider)	1:200,000
	Hydrogen Sulphide (Vignon)	1:240,000
	Stannous Chloride (Overbeck)	1:40,000
	Stannous Chloride (Schneider)	1:50,000
	Electrolysis	1:48,000
	Electrolysis and Cl+KI	1:100,000 1:150,000
	Tincture Guaiac	1:30,000
	Lime Water	1:4000
	Potassium Ferrocyanide	1:1500
	Alkaline Solutions	1:4000
Mercurous Oxide	Sodium Chloride	1:80,000
	Alkaline Solutions	1:30,000
	Potassium Carbonate	1:7000
Nickel	Potassium Xanthogenate	1:100,000
	Bromine+KOH	1:1,000,000
	Potassium Ferrocyanide	1:100,000
	Ammonia	1:10,000
	Sodium Sulphide	1:1,000,000
	Sodium Hydrate	1:10,000
Potassium	Sodium Nitrite, Cobalt Chloride and Acetic Acid	1:1000
	Platinic Chloride	1:200
	Tartaric Acid	1:230
Silver	Potassium Iodide	1:4000
	Potassium Chromate	1:10,000
	Potassium Arsenate	1:10,000
	Hydrogen Sulphide	1:25,000
	Sodium Chloride	1:24,000
	Potassium Xanthogenate	1:40,000
	Potassium Ferrocyanide	1:3000
	Electrolysis, Chlorine and Pyrogallol	1:200,000
Tin	Brucine	1:20,000
Zinc	Potassium Ferrocyanide (Mylius)	1:1,000,000
	Potassium Ferrocyanide (Jordis)	1:3,000,000
	Ammonia	1:9000
	Ammonium Carbonate	1:8000
	Ammonium Sulphide (Anriandt)	1:2000
	Ammonium Sulphide (Cooper)	1:2,500,000
	Ammonium Sulphide (Jordis)	1:50,000
	Ammonium Sulphide (Neumann)	1:100,000

* Pharm. Zeitung, xlii, page 148, (Drug Topics.)

Since it is difficult to get flues quite airtight and smooth enough not to interfere with the cleaning, and in order to prevent partial stoppages which may be caused by materials falling down during building, it has been proposed to build the flues directly of stones provided with hollows of the desired sections. In the stones of Zombrolch, of Hagen in Westphalia, made of cement, beton, etc., these hollow channels are arranged eccentrically. Three of the walls have the same thickness, the fourth is thicker. On the upper thick surface a step is formed. If, then, the stones are fitted into one another so that the thicker sides lie alternately right and left, the inner channel will be straight and the stones will rest firmly on one another.

ENGINEERING NOTES.

The first German town to adopt the motor car for cab service is Stuttgart. Rubber tired cabs run there beside the usual horse cab; they are driven by a four horse power motor, which makes them quicker than the ordinary cab, especially for long distances and country driving, and the charge is the same as for ordinary cabs.—Uhland's Wochenschrift.

It is stated the Chilean government has decided to appropriate $500,000 for encouraging the development of iron and steel foundries in that country. One hundred and twenty thousand dollars will be given to an American syndicate as a bonus for establishing an iron foundry, and the residue of the sum mentioned is to be similarly distributed. Government reports say that iron ore exists in abundance in Chile.

H. C. Fairbanks, of Sibley College, while constructing a gas engine, observed a singular though probably not exceptional phenomenon which, so far as known, has not been previously described. The machine exhibited a great loss of heater efficiency, which was unaccounted for and was not affected by any changes made in the process of repair. Finally it was suspected that the conductivity of the metal of the cast iron "fire pot" had been impaired by oxidation or otherwise, and it was replaced by a new one. The engine at once started off at full power and regained its original efficiency.

The Engineering News says: "Brazilian railways, says a Paris news item, are to be farmed out to an English-French-German syndicate. A provisional contract has been made between the Brazilian government and the Rothschild Frères, the Discount Bank of Berlin and the Comptoir d'Escompte of Paris. A company is to be formed to take over the administration of the Brazilian railways. The capital will be $10,000,000, half of which will be taken by the English group and one-quarter each by the French and Germans. One of the conditions is that this capital is to remain in Europe for two years, and numerous sinecure offices on the railways will be suppressed and abuses in administration reformed."

The authorities of the Madras Presidency have decided to invite proposals for the utilization of the water power that is at present running to waste in the flow from the Periyon Lake, says The Trade Journals Review. There are immense industrial possibilities in the scheme. The fall is approximately 900 feet, and for nine months of the year the flow varies from 500 to 1,100 cubic feet per second, the lowest average being equal to a force of 30,000 horse power. The Indian government is prepared to rent any part of the whole supply at a certain rate per cubic foot per second, so that small factories could be established; and as a large quantity of jute and other natural products abound at Madras, there is a splendid opening for extensive mills for its preparation into finished goods. The government intends to give the first year of the concession free, charging only a fifth for the second year and continuing to add a fifth for each successive year of the lease. There is also the possibility of power transmission to considerable distances. As this has already been done in other parts of the world, there is no reason why it should not be financially successful in India.

That galvanized sheets which are made of steel, with the oxide formed in rolling removed, and then coated with spelter, are not more generally used in boiler or tank works is because the advantages thereof are not sufficiently understood, says the American Boilermaker. The extreme cheapness of steel plate and improvement in manipulating same have led to the substitution of steel plate stacks and chimneys for brick. It is, however, well for boilermakers to remember that the action of moisture, especially when impregnated with sulphur arising from soft coal, has a destructive influence on steel plates, rusting rapidly, particularly in the lighter gages. This may be delayed by frequent painting or varnishing. The coating of spelter on steel sheets is impervious to moisture, and therefore the life of the metal is preserved indefinitely, especially where it may be painted with the ordinary commercial stack or boiler paints. We would remind boilermakers that unless they call the attention of their customers to this fact, they will find a large and profitable part of their business leaving them, on account of the short life of the ordinary steel stack as now made, because the first cost of the brick chimneys will be of less importance than the inconvenience and cost of having to replace a steel stack or chimney.

The following table gives the railway mileage of the five great continents of the world, says The Engineer. The first column represents the totals in 1895, the second in 1891, and the third shows the increase in the four years:

	1895. Miles.	1891. Miles.	Increase.
Europe	155,284	141,552	13,732
Asia	26,890	22,023	4,867
Africa	8,169	6,522	1,647
America	229,722	212,724	16,998
Australia	13,888	12,322	1,566
The world	433,953	395,143	38,810

The percentage of increase in mileage was greater in Africa than in any other continent; but this great percentage was only 1,647 miles. The South African Republic led in new construction, building 401 of its 616 miles between 1891 and 1895. Cape Colony followed, and it has more railroads than any other African country, followed by the French possessions Algiers and Tunis. Egypt made an addition of 31 per cent. to its mileage in the four years in question, as did also the Orange Free State. Just about half of the African mileage is in the comparatively small area of South Africa. Among European countries the rank in mileage is as follows: Germany, France, Russia, Great Britain and Austria. No other country has so much as 10,000 miles. The largest increase in mileage since 1891 has been in Russia—4,146 miles and 21·4 per cent. No other country in Europe added half so much to its mileage. But Spain gained 18·3 per cent. and Sweden 17·7 per cent. The gains in France, Germany, and Austria-Hungary were from 6½ to 7 per cent.

MISCELLANEOUS NOTES.

Salt has just been put in the allowance of food which the British government gives its sailors, though other condiments were allowed in the rations. When "salt horse" was the main staple of diet there was no need of it, but although this was changed on men-of-war long ago, the Admiralty has only recently discovered that the men have no salt. They have been obliged to buy it out of their wages for years.

Since 1797 there have been 1,100 theater fires with 10,000 fatalities, according to Mr. Sachs' "Fires and Public Entertainments," just published. Of these, 462 took place in the United States, 139 in Great Britain, and 101 in Germany, France having nearly the same number. London has had 35 fires and Paris 28. Out of 343 theaters destroyed by fire, one-half were burned within ten years after they were constructed, forty of them within the first year.

Regarding the formation of petroleum, Prof. Dr. C. Engler, an authority in this field, has become convinced, in a recent voyage to the Orient, of the correctness of his theory advanced about thirty years ago, viz., that petroleum has formed from the remains of an extinct fauna. On the other hand, the results of investigations by Cloez supported Mendelejeff's hypothesis of the formation of the petroleum by the action of water and salt solutions on carbide of iron, for Cloez obtained, by the action of water on crude iron and on magnesian iron a number of hydrocarbons of the same combination as that of earth oil.

Endless are the inventions which the bicycle has been the means of stimulating. We notice that a Glasgow inventor has patented an improved method of impregnating materials, such as chrome tanned leather or cotton, canvas or like fabrics, with a solution of India rubber, more especially the materials for use in the construction of pneumatic tires. The material, when dry and warm, is immersed in a bath of naphtha, benzine or other solvent until thoroughly saturated. This, when drained of unnecessary excess, is placed in a warm bath of India rubber, gutta percha or other solution with which the material is to be impregnated, the solution being at from 100° to 110° F. The material is then dried and treated to remove unnecessary surface deposit. The patentee does not say in what respect his materials treated in this manner will be superior to existing manufactures of this kind.

An excellent movement in behalf of ascertaining the value of different varieties of native stone found in California for structural purposes has been undertaken by Prof. Lawson, of the department of geology in the University of California, at Berkeley. From quarries or outcrops where quarries are possible, and where the stone is fairly uniform, it is proposed to secure two blocks of stone, one a twelve inch cube dressed differently on different faces to show the qualities of the stone, and a four inch cube, similarly dressed, for preservation in the college. In cases where the rock has ornamental qualities and varies in texture and color, as in the case of marble deposits, several such blocks would be required fairly to represent the prevailing characteristics; and then there may be cases where, owing to special structures, the stone will appear to better advantage in the form of slabs or columns. These specimens, properly cut by skilled operators, are to be made part of the university's permanent economic exhibit, and such a collection will, it is believed, be made of positive practical value in determining the kind of stone best adapted for constructive purposes.

Materials containing natural dyestuffs and tannin are reduced by a firm in Milan by means of sulphites or bisulphites to compounds which are more slightly soluble (with the exception of the products obtained from quebracho, hemlock and pine extracts) than the starting materials, but show a considerably better behavior in dyeing. Concerned are: Yellow wood, fustic, quercitron, hemlock, quebracho and pine. The conversion takes place at a higher temperature and higher pressure. Thus yellow wood extract, when heated from 110° to 115° C. with bisulphite of sodium of 35° B., affords a substance which produces pure yellow shades of great beauty and intensity upon alumina and a chrome mordant. One part of the new compound dyes upon alumina about equally as strong as one and a half parts of pure yellow wood extract. A similar proportion is shown by fustet and quercitron extracts. From quebracho, hemlock and pine extracts, however, upon heating with bisulphite of sodium from 100° to 150° C. products are obtained which are readily and entirely soluble even in cold water. Considering the high demands in the quick tanning processes for pure and clearly soluble tanning extracts, the new products are regarded with great interest.

A unique idea receives practical realization at the great dyeing plant of Messrs. Brownlow & Standfield, Leeds, England, in a new and peculiar method by which cloth gets a different shade on each side, the necessity of an extra lining being thus done away with. In this process the cloth or material to be treated is first dyed through in any shade of color in the usual manner, then finished by the ordinary processes, after which it is taken to a printing machine provided with a roller engraved all over uniformly with diagonal lines cut deeply and running in one direction over its surface, with diagonal lines cut less deeply and running in the other direction. This roller dips into a bath of thickened color of the required shade and carries it up to the cloth, which is by means of other rollers brought into contact with the dyeing roller; the latter, in order to prevent the color penetrating too deeply, is carefully adjusted in its pressure, and thus the second color is kept from going more than half way through the piece. Screw levers are also arranged upon each end of the roller for adjusting the pressure. After the second color has been applied the cloth is steamed and finished in the ordinary way.

The tensile strength of copper is 33,079 pounds at 122 degrees Fah.; 32,187 pounds at 212 degrees; 30,872 pounds at 302 degrees; 26,981 pounds at 482 degrees; 25,420 pounds at 545 degrees; 22,302 pounds at 602 degrees; and 11,054 pounds at 1,010 degrees Fah. When alloyed with tin to the proportion of 8 of the former to 1 of the latter, the tensile strength is 50,000 pounds per square inch of section.

SELECTED FORMULÆ.

Metal for Locomotive Cylinders.—At a recent convention of the American Railway Master Mechanics' Association one of the members gave a mixture used in making metal for locomotive cylinders, valves, and valve seats. This mixture consists of 20 per cent. steel castings, old steel springs, etc., 20 per cent. No. 2 coke iron, and 60 per cent. scrap. From this it was stated a good solid metal could be obtained, the castings being free from honeycombing, and finishing better than the ordinary cast iron mixture, over which it had the advantage of 24 per cent. greater strength. Its constituents are: Silicon, 1·31; manganese, 0·33; phosphorus, 0·65; sulphur, 0·068; combined carbon, 0·62; graphite, 2·45.

Foundry Facings.—The description of facing sand, which Mr. H. F. Frohman gives in the paper which he read before the Western Foundrymen's Association, is just about as clear an explanation as could be desired by any one seeking to know the rationale of certain operations in the ironfounder's craft. It is free of all chemical terminology, which too frequently serves to confuse and obscure simple phenomena. It explains in the simplest language exactly that which working founders want to know. He tells how the most common facing to mix with the sand is coal dust, and gives the reason for it. The crushed coal is mixed with the sand which is nearest to the surface of the mould, in order to break up the particles of sand, so that when the molten metal comes into the mould it does not fuse the sand to a hard mass similar to glass, but allows the coal to burn away, thus leaving the sand in a separated condition, so that when the casting has cooled these separated particles of sand will readily drop off. This can be verified by putting a small quantity of silica sand into a heated vessel so that the temperature will just about fuse the sand. It will melt and run together into a solid mass. There is another reason for the use of coal dust, and that is that it will help materially to vent the mould and allow the gases to escape. Coal dust for facing sand should be made from the best quality of soft or bituminous coal, containing neither slate nor phosphorus, but high in hydrocarbon gases and volatile matter, and the best gas coal makes the best dust for facing. This is the only kind of facing that is mixed with the sand. There are other facings, such as charcoal blacking, but these are either dusted on the mould or applied wet with a brush, as the class of work requires.

Decolorization of Carbolic Acid.—To decolorize the acid the following simple method, which if found reliable is sure to be largely employed, is recommended by the Pharm. Post. For purifying carbolic acid which had already become quite brown-red on account of having been kept in a tin vessel, the receptacle was exposed for a short time to a temperature of 25° C. (77° Fah.), thus causing only a part of the contents to melt. In this state the latter was put into glass funnels and left to stand for ten to twelve days in a room which was likewise kept at the above temperature. Clear white crystals formed from the drippings, which remained unchanged, protected from air and light, while by repeating the same process more clear crystals were obtained from the solidified dark colored mother lye. In this manner 75 to 80 per cent. of clear product is obtained altogether.

Deep Black Writing Ink from Logwood Extract.—Prepare a clear logwood extract solution by dissolving 200 parts of best French logwood extract in 1,000 parts of water by heating in a steam bath, place the solution aside to settle for about eight days and pour off clear from the accumulated deposit. Dissolve 200 logwood extract solution with 300 water, heat in a steam bath to about 90 C. (197° F.) and add drop by drop the following oxidation mixture prepared from 2 dichromate of potassium, 30 chrome alum and 10 oxalic acid dissolved in 150 water. Maintain the temperature for another half hour at 90° C. (197° F.), dilute with water to 1,000 total weight, add 1 per cent. carbolic acid, and allow to settle two or three days. Then express clear and fill in bottles.

Cementing Glass to Metal.—To glue glass to metal use the paste made by boiling together:

Resin	20	parts.
Soda	6	"
Potassium silicate	2 or 3	"
Water	22	"

A froth is obtained. This should be skimmed off and 50 parts of it mixed with 80 parts of plaster of Paris (gypsum).—La Science en Famille.

Cement for Caoutchouc.—The following method of repairing the cracks or fissures in articles of caoutchouc is given in the June number of L'Industrie Textile. First clean the surface of fissure or parts to be united very carefully and apply a cement composed of:

Sulphide of carbon	26	parts.
Gutta percha	2	"
Caoutchouc	4	"
Fish glue	1	"

The edges of the rent should be kept together by means of thread and the article left to dry. At the end of from twenty-four to thirty-six hours the binding thread may be removed and the cement which may have squeezed out of the fissure cut away.

Preserving Oil.—The turning rancid of oil is due to a superficial oxidation, which may be avoided by spreading over the oil a film of good whisky; this by its inferior specific weight is kept on the top of the oil, and effectually keeps the air from it. Bottles containing oil should, of course, be corked well, in addition to the above precautions being taken—La Vie Scientifique.

Blackening Aluminum.—A thoroughly good and practical way of blackening aluminum has until recently been unknown. The following, however, gives very good results: Polish the surface to be blackened with glass paper, then spread on it a thin film of olive oil, and heat slowly on a spirit flame. After a while the oil boils and takes a golden color. Then lay on another coat of oil, and heat strongly. The golden color becomes brown and soon darkens to an intense black. Let the article cool, wipe off the oil and let dry.—Cosmos.

FRANÇOIS' AIR COMPRESSOR AND ROCK DRILL.

Mr. Joseph François, of Seraing, whose name has been long known in connection with air compressing machinery, makes a fine display in the Machinery Hall of the Brussels Exhibition of compressors and rock drills. The former is illustrated by Figs. 4, 5 and 6. A special feature of this arrangement is that the springs controlling the movement of the air inlet valves are governed by a positive motion from the slide valve of the steam cylinder. It will be noticed that the clearance spaces at each end of the cylinder are reduced to insignificant dimensions, thus increasing the effective volume of air compressed with each stroke of the piston. This space is further reduced by the cold water admitted through the inlet valves for absorbing the heat developed during compression. This water flows freely into the cylinder to an amount of about two liters per cubic meter of air compressed. In the illustrations, A is the steam cylinder of the compressor; B is the air cylinder; C, the air inlet valves and the delivery valves; E F, the centers of the levers regulating the action of the springs closing the inlet valves; G is a single lever mounted on E and connected to an extension of the valve rod; H I are double levers mounted on the shaft, E F; T are the valve springs governed by the levers, H I; K is a connecting rod between H I. The following are some of the leading data of the compressor exhibited:

Diameter of steam cylinder....	12·60 in.
" air cylinder.........	11·81 "
Length of stroke................	19·69 "
Maximum speed........	60 revolutions.
Minimum "	5 "
Horse power developed with a speed of 60 revolutions per minute and an effective air compression to 71 lb. per square inch..........	25
Weight of air compressed per hour at a speed of 60 revolutions per minute	660 lb.

Two types of rock drills are also shown by the same exhibitor, and the smaller of these is illustrated by Figs. 1, 2 and 3, of which the perspective view gives a good idea of the general arrangement and Figs. 2 and 3 longitudinal and transverse sections. The drill is one of the smaller standard series, known as No. 7, because the diameter of its cylinder is 7 centimeters (2·76 in.) The general construction of the drill is that so well known by the names of the inventors, Dubois & François, but two special features are introduced to lessen the effect of shock on the mechanism at the end of each stroke. At the front end this is effected by means of a small safety cam, N, mounted in a recess on the guide of the piston rod, and of a rubber cushion, P, also in the recess, one end of the cam entering a recess in the rubber, while the other end can act on the spring, R, coupled to the valve, G. When the piston, B, strikes against the bottom of the cylinder, the cam is slightly and suddenly moved by a compression of the rubber pad produced by the shock, and the spring being released prevents the valve, G, from closing, and the air pressure immediately checks all further movement. At the opposite end of the cylinder a small auxiliary piston is placed, the rear face of which is constantly under pressure by means of a small passage leading from the valve chest, and, when the piston is driven back at the end of the stroke, the air serves as a cushion. Referring to the reference letters on the section, A is the drill cylinder; B, the piston rod coupling the drill; C, the slide valve; D, D', two pistons of different diameters; E, the valve chamber; F, a lever opening the valve, G, which is the air exhaust; H, the ratchet wheel for turning the drill; J, a guide for supporting the piston rod; L is a feed screw for advanc-

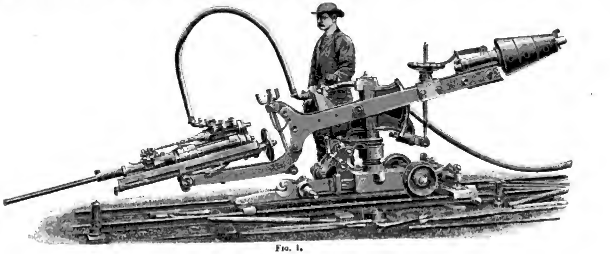


Fig. 1.

Fig. 2

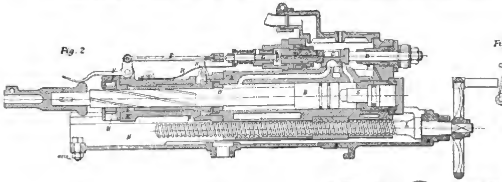


Fig. 3

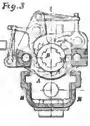


Fig. 4

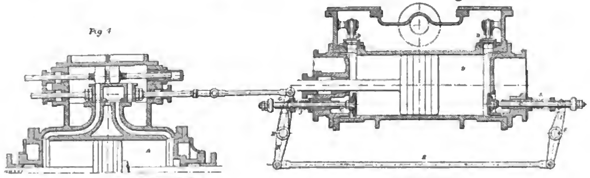


Fig. 5

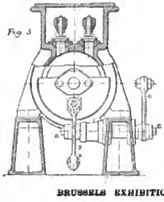
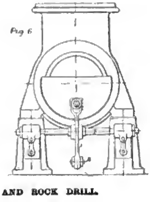


Fig. 6



BRUSSELS EXHIBITION—AIR COMPRESSOR AND ROCK DRILL.

ing or withdrawing the drill; N, the safety cam; P, the rubber cushion; R, the spring for stopping the piston at the end of its stroke; S, the auxiliary cushioning piston.—Engineering.

RIGHT AND LEFT HANDED ARMATURE WINDING.

By C. C. Hawkins, M.A.

Although the question of the "hand" of an armature winding may appear an easy one, and the rules

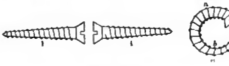


Fig. 1.—R.

which determine it are indeed simple, yet in the office or workshop these rules may have to be applied instantly and with certainty to somewhat complicated cases, and this is apt to be a perplexing matter unless the governing principles are thoroughly understood. The "hand" of a screw, by reason of which the movements of rotation and translation are connected together in two definite ways, is a fundamental fact of mechanics familiar to all. Further, a coil wound in an orderly manner round an axis presents so evidently a true analogy to a screw thread that the same difference

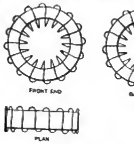


Fig. 2.—R.

between a right handed and left handed direction of winding is immediately recognized. But in the case of the armatures of continuous current dynamos, two separate questions may arise, and the distinction between the two is not always made sufficiently clear to students. Every armature consists of a number of loops, or of coils composed of many loops, connected together into a system by joining the end of one to the beginning of the next. Thus we may ask: What is the "hand" upon which the loops or coils of the armature are wound? And this ends the matter with alternators. But with continuous current armatures we may also ask a second question, viz.: What is the "hand" of the system on which the separate coils or

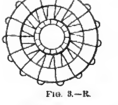


Fig. 3.—R.

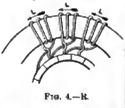
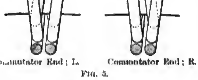


Fig. 4.—R.

sections are connected together? The screw analogy is then applied, not only to the actual winding of the coils, but also by a further extension to their system of connection. Upon the first question depends the direction in which with a given field and rotation the induced potential rises in each coil; upon the second, the general direction in which the potential rises in the armature as a whole. As a rule, the hand of the system is the same with the hand of the coils, but this is not always and necessarily so, as is amply proved by the fact that in certain cases the actual loops have no



Commutator End; L. Commutator End; R.

Fig. 5.

hand at all; yet in such cases the system still has a "hand" assigned to it by analogy and conventional agreement.

The most convenient formula by which to test the "hand" of an armature coil is the following: "If in any helix with its axis placed horizontally an observer starts from the upper portion of a loop, and traces it toward himself and thence onward, he will be led to another loop further to his right if the helix be right handed, or further to the left if the helix be left handed (Rule I)." A right handed screw is a right handed screw, however we look at it, so that it is a matter of indifference whether we are standing on one side or the other when we apply the formula (cf. i and ii, Fig. 1); or, if the same be coiled into a ring, the observer may start from either the outside or inside of the ring so long as it is always the upper portion of a loop (e. g., in iii, Fig. 1, either from a or b) from which he commences to trace the thread toward himself. But the important corollary to be deduced from the circular screw when viewed from the side (as in Fig. 1, iii) is that if we start from any part of the thread on the out-

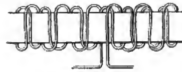


Fig. 6.—R.

side of the circle and trace it toward our point of view, we pass round the circle in a clockwise direction if the thread be right handed, and in a counter clockwise direction if it be left handed. This corollary will be found to furnish the criterion by which the second of our two questions is answered.

In the continuous current ring or discoidal ring armature, if each section of the winding as marked by the commutator segments is a simple loop, the "hand" of the loops and the hand of the system as a whole are one and the same question, and the answer to the one must necessarily be the answer to the other. The loops combine into a simple helix (Fig. 2) and our first rule is immediately applicable. It is immaterial at which end of the armature we stand, or where the commutator segments may be placed. If the commutator be formed by the external portions of the loops, as in some Continental multipolar machines, then, in applying Rule I, we start from a segment and trace it toward ourselves, and thence through the interior of the ring.

Fig. 7

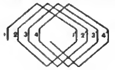


Fig. 8.

If the commutator is not arranged on the external periphery, then, when we start from any external wire and trace it toward ourselves, we are led to a segment and thence onward round the commutator in a clockwise direction if the winding be right handed as before. It makes no difference at which end we stand—e. g., in Fig. 3 the commutator might be at either end or centrally situated in the interior. But in the ordinary armature where the commutator is at one end, if we start from a commutator segment we must fix the direction of tracing with reference to the end at which we stand. It is simplest to consider the armature from the commutator end, and our second rule therefore takes the following form for ring armatures: "With a commutator at one end and standing at that end, if we start from a commutator segment and trace the winding away from our point of view through the interior of the ring, we pass round the segments in a clockwise direction if the

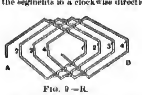


Fig. 9.—R.

armature system be right handed, or in a counter clockwise direction if it be left handed (Rule II A)."

If in a ring armature each section is composed of several loops in one layer on the outside, the hand of the system should be the same as the hand of the coils. It need not be so, as shown by Fig. 4, where the direction of each coil of three loops is left handed, while the general system is right handed. The winding then progresses round the armature in one direction while the coils themselves progress backward against this direction, and, in consequence, the commutator connections unnecessarily cross the width of the coil. Further, if the coils are in the same field, and the general direction of the rise of potential round the commutator or armature is shown by the large arrow (Fig. 4), the rise of potential in each coil is in the opposite direction, as shown by the small arrows; hence the difference of potential between adjacent turns is a maximum and

Side B turned up.

Fig. 10.

Side A turned up.

Fig. 11.

equal to twice that of one coil, which is a disadvantage. Thus, the arrangement of Fig. 4 would not practically be used, but it serves to illustrate how the system has metaphorically a "hand," no matter what may be the hand of the separate coils. We require to know the general direction of the current into or out of the brushes, and this is determined by the system of connection. In order, then, to find the conventional hand of the system, all that we have to do is to stand at the commutator end and trace the winding through the interior of the ring away from our point of view; we then pass from segment to segment round the commutator in a clockwise direction if the system is right handed. We need only follow one loop in each coil, and by so doing we virtually describe an imaginary helix as it were on the top of the real coils, and according to the hand of this helix the armature is right or left handed. Thus, if we follow one loop out of each set of three in Fig. 4, we in effect describe upon the actual coils the right handed helix of Fig. 3.

If in each section of a ring armature the turns are to be arranged in more than one layer, and the coil has a width of more than one turn, it is usual to commence

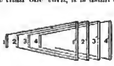


Fig. 12.—R.

winding the coil at or near the center of the total length of wire in the coil, so as to bring both the free ends to the outside layer. Under these circumstances the hand of the system should be the same as the hand of the bottom layer, since this avoids unnecessary crossing of the width of the coil by the commutator connections. The minimum number of turns per section which come under this rule is three, as seen in Fig. 5, which shows two such sections; the hand upon which the system is connected up should then be the same as that of the coil which has a lower layer of two turns, i. e., coil, A A, in Fig. 5. This coil, A A, must be wound first, so that if the armature is to be right handed we must start to wind from the right, and if left handed from the left. With a larger number of turns per section, the layers of each section are alternately right and left handedly wound; if the number of layers on the outside be two or any even number, the ends fall in the center of the coil (Fig. 6), while if the layers be three or any uneven number, they come to the outside edges, but in all

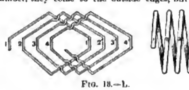


Fig. 13.—L.

cases the sections should be connected up with the same hand as that of the bottom layer of each coil.

Just as a watch spring may be coiled up in a clockwise or counter clockwise direction, but has no hand until its inner end is pushed or pulled through it, so a flat coil such as might form part of the armature of a disk alternator (Fig. 7) has by itself no hand. In exactly the same way, from the mere representation of a coil on the flat, such as Fig. 8, we cannot find out the hand; we must know which wires are underneath and which lie on the top where they cross one another. Fig. 8 may thus stand for three distinct cases. First, let the wires to the right lie above those to the left, as indicated in Fig. 9 by the small overarching half circles at each end. The winding is then right handed, as our fundamental rule will show. If we imagine a core to be passed through the loops as they are situated in Fig. 9, the wires on the side, B, will be at the top (Fig. 10) in the same order as in Fig. 9. Starting, then, from the upper portion of any loop, such as 1, and tracing it toward our point of view, we are led on to another wire, 2, which is further to our right. If side, A, be brought up to the top, as in Fig. 11, the wires will run toward the right in the order 4, 3, 2, 1—the reverse of Fig. 9—and again by Rule I, the winding is seen to be right handed. When Fig. 9 is translated into the long and short bars of an ordinary drum armature, with end connectors, 1' 2' 3' 4' must be the long bars, since they cross over the end connectors, and we thus get Fig. 12. In order to test the hand of such a diagrammatic winding by our first rule, we must start from a long bar on the top of the armature, and trace it toward our point of view. To start from a short bar on the top of the armature is tantamount to starting from the lower portion of a loop in a ring armature, instead of the upper portion.

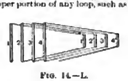


Fig. 14.—L.

Secondly, the wires to the left of Fig. 8 may lie above those to the right. We then get Figs. 13 and 14, which

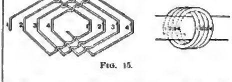


Fig. 15.

are the exact reverse of Figs. 9 and 12, and the winding is left handed.

A third case still remains, in Fig. 8. Let the wires to the right lie above those to the left at one end of the armature and below them at the other end. We thus get in Fig. 15 a combination of half of Figs. 9 and 13, and the winding of the loop has no hand at all. If a core be inserted through the loop as shown at the side of Fig. 15, it is seen that the winding is not a helix but an involved knot; yet it forms a perfectly valid drum winding. When translated into a bar armature with

end connectors, the bars are of the same length (Fig. 16), but set so that at each end of the completed armature alternate bars project, and the same bar does not project at both ends.

If a drum armature has only one loop in each section, and is wound as in Fig. 9 or Fig. 13, it is right handed in the first case and left handed in the second case, the hand of the system being necessarily the hand on which the loops themselves are wound. If a commutator is connected to the junctions at either end of Fig. 9, let us start to trace the winding from a segment, when standing at the commutator end; then if we proceed away from our starting point down a wire that forms one of the lower set leading away from the commutator, we pass round the commutator in a clockwise direction. Contrariwise, if a commutator be connected to either end of Fig. 13, and, standing at the commutator end, we proceed away from the commutator down one of

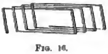


FIG. 16.

the lower layers of wire, we pass round the segments in a counter clockwise direction. Our second rule therefore takes the following form in drum armatures: "Standing at the commutator end, if we start from a commutator segment and trace the winding away from our point of view down the lower arm of a loop and so round to the next segment, we pass round the commutator in a clockwise direction if the armature be right handed, or in a counter clockwise direction if it be left handed (Rule IIB)." The condition "down the lower arm of a loop" is the counterpart of the condition "through the interior of the ring" in the case of ring armatures. In a bipolar armature the lower arm of a loop evidently leads away to the under side of the core which we imagined to be threaded through the loops as they are shown in Figs. 9 and 13, and the analogy is clear, although it is not so evident in multipolar drums, where the coils are comparatively flat. If the winding is composed of bars and end connectors and the commutator is attached to the ends of the long bars, the rule becomes even simpler; we must always proceed away from the segment which forms our starting point down an end connector, and not down a bar. It is quite immaterial on which side of the shaft any connector passes, except so far as the length of an end connector is affected. If the commutator is attached to the center of evolute end connectors, then as we pass down a segment we come to the two arms of the connector, one of which forms part of the outer whorl of spirals and the other part of the inner whorl; in this case, we must always proceed down the arm which is in the inner set of spirals next to the armature core, and so to the end of a short bar.

In the case of Fig. 15 all the above holds equally good; but now, since the loops have no hand, we are dealing simply with the metaphorical "hand" which is conventionally assigned to the system. In this case the hand of the system varies with the end of the armature to which the commutator is attached, since the bars which project at one end do not project at the other end.

Fig. 17 shows that in all cases, if we pass round the segments by Rule IIB, in a clockwise direction, we are virtually describing on the actual loops a right handed

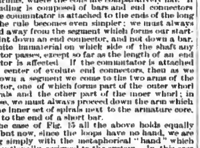


FIG. 17.—R.

spiral, and, as far as the question of the system is concerned, it is quite immaterial, not only on which side of the shaft the end connectors pass, but whether any bar at the far end projects or does not project.

If each section of the drum armature has several loops, these may be wound according to either Figs. 9 or 13, and the hand of the system should then follow the hand of the loops, for the same reasons as in a ring armature. Fig. 15 would not be a practical method for a wire wound armature with several loops per section, but is perfectly feasible with a bar wound armature, and in this case the hand of the armature is fixed according to the end at which the commutator is attached.

In single phase alternators the coils are, as a general rule, alternately right and left handed, although whether this is so depends entirely upon what is the most convenient method of joining together the separate sections. In any case the system, as a whole, has no hand, since the coils do not unite into a spiral.—The Electrician, London.

ART AND NATURE IN LANDSCAPE GARDENING.

IN the spring we receive the most frequent inquiries from amateur planters about shrubs, trees and herbs for what they call "decorative planting." Many persons who have acquired new homes in the country or in the suburbs of cities are moved to beautify them in some way, and the first thought that occurs to every one is to secure an abundance and variety of what are known as "ornamental" plants. It is not our purpose to make out any such list, and even if we considered it advisable, the season is too far advanced to begin to arrange for planting. Nevertheless, these requests suggest a word or two of counsel which may as well be repeated at one season as another. We have no novel doctrine to advance, nothing but a few principles which do not change every year like fashions in millinery.

The spring planting of trees and shrubs is practically over for the year, and where these have been planted by novices it is probable that they have been badly selected and planted in improper positions. Nevertheless, this fact is not utterly discouraging, for when once a land owner begins to take any serious interest in his home grounds it is probable that the habit will grow on him and become a lifelong and increasing source of refreshment and refinement. We have said that both planning and planting by novices are, as a rule, worse than unsatisfactory, for if there is any art which needs original aptitude, special training and long experience for the highest success, it is the art of planting public and private grounds. This statement will be admitted by most men of cultivation, but practically they do not realize its truth. An engineer or a botanist is considered qualified to plan a public garden. Places of remarkable natural beauty, when once they are acquired by a city, are often put under the control of commissioners, who may have a fair education and experience in business, and if they have in addition to this what is known as good taste they are esteemed perfectly competent to preserve the scenes, to develop their charms and to devise facilities for exhibiting them. Gentlemen of wealth who have some cultivation consider themselves quite able to lay out their own places, especially if they have the help of some journeyman gardener, who often has no appreciation of the character and beauty of the grounds, and whose first work will be to despoil the scenery of all that makes it really valuable, and then begin the work of decorating it with flower beds, golden elders and purple-leaved shrubs of various kinds. The worst part of the matter is that the men who are utterly lacking in their ability to foresee what a piece of ground will look like a few years after they have set out to "improve" it, are quite unconscious of their lack of qualification, and have not the slightest idea that any such qualification is needed. Even if they were capable of taking such a look into the future, they would not be competent to pass any intelligent judgment on the result of their work. The fact is that no one but a man of genuine creative faculty can see just what elements in a landscape are the essentials that ought to fix its character, or can estimate the relative proportional importance which should be given to each one so as to produce the best combined effect and invest the whole with a charm which is distinctly its own.

This brings us again to the point that for the treatment of any piece of ground, public or private, the counsel of a landscape gardener of recognized standing should be at once taken. The novice who insists upon improving his own grounds must educate himself through his own mistakes. If he begins at the wrong end and buys a great many more novelties and oddities among trees and shrubs than he needs, and then wanders around in his lot for a place to plant them, he will soon see that his crowded grounds have no unity of expression or of purpose. If, however, he will endeavor to set before his mind a clear and definite picture of what his house and grounds together are to look like, and will then attempt to construct his picture, he will not be led to choose a plant simply because the catalogue pronounces it beautiful, but because it is necessary to complete his idea and give expression to his thought. All this sounds very simple, but he will find it no easy task to create such a picture even in imagination. But if he has in mind a design which is reasonably distinct, and for the details of which he can give intelligent reasons, he will certainly learn some things by his experience which very few of his fellow men understand. When he studies his house and grounds not only as a unit, but in their relation to what is beyond them, and endeavors to shut out what is distracting or unsightly and preserves within a fitting framework the view of distant prospects that are pleasing, and when he attempts to provide for conveniences in the way of buildings and walks and place them so that they do not disturb his picture, he will learn that it requires not only taste, but hard study, to solve the complex problem that he has in hand. He will learn, too, that even within the modest limits of his home acre there are chances for an individuality of plan and for a refinement and finish in the details which an artist of the first rank would not deem unworthy of his powers.

The objection is sometimes made to the work of artists in landscape that, after all, purely natural scenery is the most impressive, and the art of man can only interfere with nature to belittle it or weaken its strongest effects. But the true artist aims to help, and not to hinder nature. Even the broadest landscape can be improved, that is, adapted to human use and enjoyment, if it is treated in a reverent spirit. We do not attempt to thwart nature when we open her thickets and help magnificent trees in their development. We are working with nature if we encourage a screen of foliage deep enough to exclude the intrusion of some disagreeable object, or if we open vistas which will uncover to us the sky line made by a mountain range. Nature alone does not spread out for us broad stretches of meadow, but if we come to her aid she will give to us all the turf we need. That is, the real artist emphasizes and intensifies here or subdues and qualifies there. He uses the art that mends nature, working in harmony with, and not against her. The truth is not thoroughly comprehended by persons who consider the true work of the landscape gardener to be the planting of flower beds and of ornamental shrubs. But, after all, it is this broad and catholic art which alone is satisfying everywhere, and which is just as useful in the preservation of the Yosemite Valley or the scenery of Niagara as it is in planning a pastoral park or the grounds about a country house.—Garden and Forest.

ON THE ASCENT OF WATER IN TREES.*

WITHIN the last few years the problem of the ascent of water has entered on a new stage of existence. The researches which have led to this new development are of such weight and extent that they might alone occupy our time. It will be necessary, therefore, to avoid, as far as possible, going into ancient history. But it will conduce to clearness to recall some of the main stepping stones in the progress of the subject.

The two questions to be considered are: (1) What is the path of the ascending water? (2) What are the forces which produce the rise?

(1) The first question has gone through curious vicissitudes. The majority of earlier writers assumed that the water traveled in the vessels. This was not, however, a uniform view. Cæsalpinus, 1583, seems (Sachs' "History of Botany," English Trans., p. 451) to have thought that water moved by imbibition in the nerves. Malpighi and Ray held that the vessels serve for air and the wood fibers for the ascent of water. Hales ("Vegetable Staticks," p. 130), who believed in the sap vessels as conduits, speculated on the passage upward of water between the wood and the bark. Also (loc. cit., p. 19) that water may travel as vapor not in the liquid state. In the present century, Treviranus (Sachs' "History"), 1835, held that water traveled in vessels; De Candolle, 1832, that the intercellular spaces were the conduits. In Balfour's "Manual of Botany," 1863, vessels, cells and intercellular spaces are spoken of as transmitting the ascending water.

The change in botanical opinion was introduced by the great authority of Sachs,* who took up Unger's view† that the transpiration current travels in the thickness of the walls as water of imbibition.

Then followed the reaction against the imbibitionists—a reaction which has maintained its position up to the present time. Boehm, who had never adopted the imbibition theory, must have the credit of initiating this change; his style was confused and his argument marred by many faults, but the reaction should in fairness be considered as a conversion to his views, as far as the path of the traveling water is concerned. Nevertheless, it was the work of others who principally forced the change on botanists, e. g., Von Höhnel (Pringsheim's Jahrb., xii, 1879), Elfving (Bot. Zeitung, 1882), Russow (Bot. Centr., xiii, 1883), R. Hartig ("Ueber die Vertheilung," etc., Untersuchungen aus dem Forst. Bot. Inst. zu München, ii and iii), Vesque (Ann. Sc. Nat., xv, p. 5, 1883), Godlewski (Pringsheim's Jahrb., xv, 1884), and others.

(2) The second question has a curious history and one that is not particularly creditable to botanists generally. It has been characterized by loose reasoning, vagueness as to physical laws and a general tendency to avoid the problem, and to scramble round it in a mist of vis à tergo, capillarity, Jamin chains, osmosis and barometric pressure.

An exception to this accusation (to which I personally plead guilty) is to be found in Sachs' imbibition theory, in which, at any rate, the barometric errors were avoided, though it has difficulties of its own, as Elfving has pointed out.

But the most hopeful change in botanical speculation began with those naturalists who, concluding that no purely physical causes could account for the facts, invoked the help of the living elements in the wood. To Westermaier (Deutsch Bot. Ges., Bd. i, 1883, p. 371) and Godlewski (Pringsheim's Jahrb., xv, 1884) is due the credit of this notable advance, for whether future research uphold or destroy their conclusions, it claims our sympathy as a serious facing of the problem by an ingenious and rational hypothesis.‡

We may pass over the cloud which arose to witness for and against these theories and proceed at once to Strasburger's great work (Leitungsbahnen, 1891), in which, with wonderful courage and with the industry of genius, he set himself to work out the problem de novo, both anatomically and physiologically. In my opinion it is difficult to praise too highly this great effort of Strasburger's.

Strasburger's general conclusion is now well known. He convinced himself that liquid can be raised to heights greater than that of the barometric column in cut stems, in which the living elements have been killed. Therefore, the cause of the rise could not be (1) barometric pressure, (2) nor root pressure, (3) nor could it be due to the action of the living elements of the wood. His conclusions may be stated as follows:

(a) The ascent of water is not dependent on living elements, but is a purely physical phenomenon.

(b) None of the physical explanations hitherto made are sufficient to account for the facts.

Strasburger has been most unjustly depreciated, because his book ends in this confession of ignorance. I do not share such a view. I think to establish such distinct, though negative, conclusions would be, in this most nebulous of subjects, an advance of great value. Whether he has established these conclusions must of course be a matter of opinion. To discuss them both would be to go over 300 pages of Strasburger's book, and will not here be attempted. Conclusion (a) that the ascent is not dependent on living elements must, however briefly, be discussed, because it is here that the roads divide. If we agree with Strasburger, we know that we must seek along the physical line; if we differ from him, we are bound to seek for the missing evidence of the action of the living elements.

Schwendener's Criticism.—Perhaps the best plan will be to consider the most serious criticism that has been published of Strasburger's work, namely, Schwendener's paper "Zur Kritik," etc. (K. Preuss. Akad., 1892, p. 911.)

Schwendener objects that although a continuous column of water cannot be raised by air pressure to a greater height than that of the barometric column, yet when broken into a number of columns, as in the case of a Jamin chain, that a column considerably over 10 m., even as much as 13 or 14 m., of water can be suspended. This, though not fatal to Strasburger's conclusions, is no doubt a serious criticism. For if 13 m. can be supported, some of Strasburger's experiments are inconclusive. He finds that a branch can suck up a poisonous fluid to over 10 m., and, as above explained, argues that all ascent above that height, not being due to barometric pressure or to the living elements (since the wood is poisoned), is for the present inexplicable. But, if Schwendener is right, the effect above 10 m. may have been due to atmospheric pressure. Askenasy (loc. cit. infra, 1895, p. 6) objects to Schwendener that the supposed action cannot be continuous. By repeating the diminution of air pressure at the upper end, the movement of water becomes less

* A paper read before Section K of the British Association at the Liverpool meeting, by Francis Darwin, F.R.S. (Revised January 20, 1897.)—From Nature.

* Physiol. Végétale (French Trans.), 1868, p. 225, and more fully in the Lehrbuch. Sachs also partially entertained Quincke's well-known suggestion of movement of a film of water on the surface of vessels.

† Sitz. k.k. Akad. Wien, 1868. Dixon's and Joly's paper in the Annals of Botany, September, 1895, gives evidence in favor of a certain amount of movement of the imbibed water.

‡ It is of interest to note that Hales, in speaking of the pressure which he found to exist in bleeding trees, says: "This force is not from the root only, but must also proceed from some power in the stem and branches." ("Veg. Staticks," 127, p. 110.)

and less, and sinks to almost nothing. Askenasy adds, moreover, that the amount of water which could be raised according to Schwendener's theory would be very small.

One difficulty about Schwendener's theory is that the result depends on the length of the elements of which the chain is made up (each element being a water column plus an air bubble). In his paper, "Ueber das Saftsteigen" (K. Preuss. Akad., 1886, p. 561), he finds that the elements of the chain in Fagus equal in round numbers 0·5 mm. In his paper (K. Preuss. Akad. Sitz., 1893, p. 842), "Wasserbewegung in der Jamin'schen Kette," he finds the element in Acer pseudo-platanus = 0·9 mm., in Acer platanoides and Ulmus effusa = 0·2. But the calculation (1892, p. 934) is based on the existence of a chain in which the water columns are each 10 mm. in length, a condition of things which he allows does not occur in living trees.

But even if we allow Schwendener to prove theoretically the possibility of a Jamin chain being raised to a height much greater than that of a barometric column, I do not think he invalidates Strasburger's position. Schwendener's idea necessitates the traveling of a Jamin chain as a whole, i. e., the translation not only of water, but of air bubbles. But this cannot (as Strasburger points out) apply to his experiments on conifers, in which the movement of air to such an extent is impossible ("Ueber das Saftsteigen," Hist. Beiträge, v, 1893, p. 50). And for the case of dicotyledonous woods, Strasburger has shown that the movement of air is excluded by the fact that transverse walls occur in the vessels at comparatively short distances. In Aristolochia the sections may be as long as 3 m., but in ordinary woods, according to Adler (as quoted by Strasburger), we get: Alnus, 6 cm.; Corylus, 11 cm.; Betula, 12 cm.; Quercus, 57 cm.; Robinia, 69 cm. These facts seem impossible to reconcile with Schwendener's views.

Action of the Poisonous Fluids in Strasburger's Experiments.—The question whether the living elements are killed in Strasburger's experiments is of primary importance in the problem.

Schwendener does not criticise it at length; he seems to assume (Zur Kritik, loc. cit., 1892, p. 935)—as far as I can understand—that since the death of the tissues extends gradually from the cut end upward, there are living cells in the upper part which may still be effective. He also doubts "whether the cells were always killed at once." The first objection of Schwendener's may or may not be sound, but in any case it does not (as Strasburger points out) account for the experiment (Hist. Beitr., v, p. 12) in which an oak stem was poisoned by picric acid, and three days afterward was placed in fuchsin picric. The second reagent had to travel in tissues already killed with picric acid, yet a height of 22 m. was reached.

The question whether the reagents kill the cells in Strasburger's experiments does not lend itself to discussion. It is difficult to see how they should escape, and we have Strasburger's direct statement that the living tissues were visibly killed. It must not be forgotten that, in some of his experiments, the death of the tissues was produced by prolonged boiling, not by poisons (Leitungsbahnen, p. 646). Thus the lower 12 m. of a Wistaria stem were killed in this way, yet liquid was sucked up to a height of 108 cm. In the Histolog. Beitr., v, p. 64, he has repeated his air pump experiment, using a boiled yew branch, and found that eosin was sucked up from a vessel in which almost complete vacuum was established; so the action of living elements and of atmospheric pressure was excluded.

On the whole, the balance of evidence is, in my judgment, against the belief that the living elements are necessary for the rise of water. In other words, I think we should be justified, from Strasburger's work, in seeking the cause of ascent in the action of purely physical laws.

Strasburger's General Argument from the Structure of Wood.—It seems sometimes to be forgotten that, apart from the physiological or experimental evidence, there is another line of argument founded on the structure of wood. Strasburger's unrivaled knowledge allows him to use this argument with authority, and he seems to me to use it with effect. Thus (Hist. Beitr., v, p. 17) he points out that though in coniferous wood the action of the living elements in pumping water is conceivable, yet this is far from being universally the case. He points out that in the monocotyledons such theories meet with almost unconquerable difficulties. This is, he says, especially the case in Dracæna. He goes on to point to difficulties in the case of such dicotyledons as Albizzia. The case may perhaps best be put in the generalized manner that Strasburger himself employs (loc. cit., p. 20). If the living elements are of such importance as Godlewski, Westermaier and Schwendener hold, we ought not to find these difficulties; we ought rather to find structural peculiarities pointing distinctly to the existence of such functions. For instance, we ought to find the tracheal water path actually interrupted by living elements which might act like a series of pumping stations one above the other. It should, however, be remembered that if we deny the importance of the medullary rays and other living elements in raising water, we ought to be able to point more clearly than we can at present to the function of the medullary rays and to structural adaptations to these functions.

The Work of Dixon and Joly and of Askenasy.—I now pass on to the recent work in which Strasburger's indications to search along a purely physical line have been followed. In the paper of Dixon and Joly (Proc. Roy. Soc., vol. lvii, 1894, No. 340) the suggestion was for the first time made that the raising of water to the tops of trees depends on the quality which water possesses of resisting tensile stress. To most botanists the existence of this quality is a new idea. To believe that columns of water should hang in the tracheals like solid bodies, and should, like them, transmit downward the pull exerted on them at their upper ends by the transpiring leaves, is to some of us equivalent to believing in ropes of sand. The idea is more fully treated in the Phil. Trans., vol. clxxxvi, and in the Annals of Botany, vol. viii. The same leading idea occurred independently to Askenasy, who has published it in the Verhand. d. naturhist. med. Vereins Heidelberg, N. F., Bd. v, 1895, and N. F., Bd. v, 1896.

Askenasy has earned the gratitude of his botanical readers by giving some of the evidence which demonstrates the existence of this property of water.* A tube a meter in length was filled by Donny with water, and the remaining space was as far as possible freed from air. When the tube was placed vertically, the water column at the upper end hung there and could not be made to break or free itself from the glass by violent shaking. Berthelot filled a thick wall capillary tube completely with water at 28°-30° C.; it was allowed to cool to 18°, so that the space left by the shrinking of water was filled with air. It was then sealed up and again warmed to 28°-30°, so that the air was dissolved in the water. When it was allowed to cool again it retained its volume, filling the tube completely. A slight shake, however, allowed the water to break and return to its proper volume at 18° with the appearance of a bubble of air. In this experiment the water contained air, yet it seems to have been until recently assumed by some physicists that to show cohesion, water must be air free. If this were the case, the application of the principle to plants would be impossible. Dixon and Joly have, however, proved that this is not so, and this forms an important part of their contribution to the subject.

They also † investigated the amount of tension which water under these circumstances will bear, and found it about equal to seven atmospheres. If, therefore, the leaves at the top of a tall tree can exert the requisite upward pull on the water in the trunk, it seems certain (if no other condition in the problem interfere) that the pull can be transmitted to the level of the ground. This opens up the question whether the leaves can exert this traction on the water in the tracheals, and what is equally important, are there any factors in the problem incompatible with the theory?

(1) The Sucking Force of the Leaves.—In Dixon and Joly's first paper (Phil. Trans., pp. 563, 565) they assume that tractional force is given by the menisceses "formed in the membranous réseau of the evaporating cell walls," as well as possibly by the osmotic action of the cells of the mesophyl. We shall take these theories in order. Our knowledge of the cell wall does not allow us to believe in the existence of pores visible with even the highest powers of the microscope. Dixon's more general expression (Proc. Roy. Irish Acad., Jan. 13, 1896, p. 767), "surface tension forces developed in the substance of the walls of the evaporating cells," is therefore preferable. But Askenasy seems to me to state the matter much more conveniently by using the term "imbibition" (loc. cit., 1895, p. 10). The force with which vegetable membranes, e. g., the thallus of Laminaria, absorb water has been demonstrated by Reinke and others, and the existence of such a force is familiar to botanists.

Both Askenasy (loc. cit.) and Dixon and Joly (Annals of Bot., September, 1895) have pointed out that the force of imbibition, or the surface tension forces, as the case may be, can exert a tractional effect on the water in the tracheals, when the turgescence of the mesophyl has been destroyed. But Askenasy in his original paper (1895), Dixon in the January, 1896, paper, and again Askenasy in his second paper (March, 1896) have also considered the imbibitional or surface tension forces in connection with the turgescent cell. It must clearly be understood that this does not remove imbibition from the problem. The sun's heat causes the evaporation of the water with which the walls of the mesophyl cells are imbibed; this water is replaced by imbibition from the cell sap. The concentration of the cell sap so produced maintains the osmotic force of the cell, which again exerts suction on the water on the tracheals.‡

I have now given, in its simplest form, the modern theory of the rise of water. Apart from the main idea, it combines the points of several familiar views. Imbibition becomes a factor of paramount importance, though not in the way that Sachs employs it. The suspended threads of water remind us of Elfving's capillary theory, while the living element factor is represented by the turgescent mesophyl cells.

Resistance.—It is not possible to discuss the question whether the tractional forces in the leaf are sufficient for the work imposed on them until we know what is the resistance to the passage of water through wood. For it is clear that the work done by the leaf includes not only the lifting of a given column, but the overcoming of the resistance to its flow.

The resistance to the flow of the transpiration current is in want of farther investigation. Janse (Pringsheim's Jahrb., xvii, 1887, p. 1) has discussed the question, and points out (loc. cit., p. 36) that two kinds of resistance must be reckoned with. The first (which he calls statical) is illustrated by means of a cylinder of Pinus wood fixed to the short arm of a J tube filled with water, when it was found that in five days the level of water in the long arm was only 1 mm. above that in the short arm.§ That is to say, when time enough is given, the resistance is practically nothing. Janse has also investigated the resistance to the passage of water flowing through wood at the rate of an ordinary transpiration current. His method seems to me open to criticism, but this is not the place to give my reasons. His experiments give a wide range of results. With Pinus strobus a pressure of water equal to ten times the length of the wood was required to force water through at a pace equal to the transpiration current. In Ginkgo the pressure was twenty-one times the length of the wood. Strasburger (Leitungsbahnen, p. 779) has repeated Janse's experiment, and finds a column "several times the length of the object" necessary. Nägeli ("Das Mikroskop," 2d edit., p. 385) found that 760 mm. of mercury were needed to force water through fresh coniferous wood at the rate of 1/10 mm. per second, i. e., at 180 mm. per hour. If we allow one meter per hour as a fair transpiration rate (Sachs' "Arbeiten," ii, p. 182), we get a pressure of 5 atmospheres required to produce such a flow. To return to Janse's experiments: even if we assume that the resistance (expressed in water) = 5 times the length, it is clear that with a tree 40 m. in height the resistance of 20 atmospheres has to be overcome. This would not be a pressure greater than that which osmotic forces are able to exert, but when we come to a tree of 80 m. in height, and a resistance of 40 atmospheres, the thing becomes serious.* A great difficulty in the question of resistance is that the results hitherto obtained are (though here I speak doubtfully) much greater than those obtained by physicists for the resistance of water flowing in glass capillaries. Until this discrepancy is explained it is rash to argue from our present basis of knowledge.†

Is the Osmotic Suck Sufficient?—The osmotic force of a turgescent cell is usually measured by its power of producing hydrostatic pressure within the cell. Thus, De Vries ("Untersuchungen über d. mechanischen Ursachen der Zellstreckung," 1877, p. 118) investigated the force necessary to extend a plasmolyzed shoot to its original length; Westermaier (Deutsch. Bot. Ges., 1883, p. 382) the weight necessary to crush a tissue of given area; Pfeffer (Abh. k. Sächs. Ges., 1893) the pressure exerted by growing roots; Krabbe (K. Akad. Berlin (Abhandlungen), pp. 57, 69, 1884) the pressure under which cambium is capable of maintaining its growth.

The figures obtained by these naturalists have a wide range; it may be said that the hydrostatic pressure varies between three and twenty atmospheres.

Another method is to ascertain the osmotic strength of the cell sap in terms of a KNO_3 solution, and calculate the pressure which such a solution can produce. According to Pfeffer (Pfeffer, Phys., i, p. 53), 1 per cent. KNO_3 with artificial membrane gives a pressure of 176 cm. = 2·3 atmospheres. De Vries (Pringsh. Jahrb., xiv, p. 527) calculates that in a cell a 0·1 equivalent solution (practically = 1 per cent.) gives a pressure of three atmospheres. We may, therefore, take it as between 2·3 and 3 atmospheres. Now, De Vries found that beetroot requires 6 to 7 per cent. KNO_3 to plasmolyze it; this would mean 15 to 21 atmospheres. I do not know what is the greatest pressure which has been estimated in this way. Probably Wieler's (Pringsh. Jahrb., xviii, p. 82) estimate of the pressure in the developing medullary ray cells of Pinus sylvestris at twenty-one atmospheres is the highest. It is clear that investigation of the osmotic capacity of leaves for high trees is wanted, also investigations of the variation in osmotic power produced by varying resistances in the flow of the current. The experiments of Pfeffer and others‡ show that the osmotic strength of cell sap is capable of great adaptation to circumstances—cells respond by increased turgescence to various stimuli. Whether they can respond sufficiently to account for the ascent of water is another question.

My own opinion is that the question of resistance to the flow of water is a difficulty which the authors of the modern theory have not sufficiently met. Unless it can be shown that the resistance to the flow of water in wood is less than that indicated by existing researches, we must face the fact that we do not at present know of osmotic forces which we can suppose capable of raising water to a greater height than forty meters.

Continuity of the Water in the Tracheals.—The theory we are considering apparently requires that there shall be continuous columns of water from leaf to root, because a break in the column means a collapse of the machinery. This seems at first sight a fair assumption, though I doubt its complete correctness. It is in any case worthy of discussion. It has been constantly insisted on by Sachs and others that at the time of most active transpiration the vessels contain air, and not water. It is, therefore, a violent disturbance of our current views to believe in continuous columns of water.

For evidence on this point we are chiefly indebted to Strasburger. It is a remarkable fact that he should, without any theory to encourage such a view, have come to the conclusion that approximate continuity of water columns is a condition of primary importance, and that he should have made out the cognate fact that the whole of the alburnum need not be simultaneously occupied by a transpiration current; parts of it may be so occupied, while parts of it are filled with air, and do not function as waterways. This is a valuable contribution to knowledge, and to the adherents of the new theory it is priceless; the very existence of their hypothesis may depend on it.

Strasburger's statements and reasoning are by no means accepted by every one; for instance, Schwendener refuses to take them seriously (K. Preuss. Akad., 1892, p. 931).

Strasburger has microscopically examined the condition of the tracheals as regards air.§ He found in the spruce fir in July "almost no air bubbles" in the wood of the current year, but air in considerable quantity in four-year-old wood. In the same month Pinus Salzmanni (Laricio) showed scattered bubbles in the spring wood of last year, and more in the autumn wood. In a larch there were only very occasional bubbles in the two last years' wood. In the silver fir the current year's wood was practically free from air; the air increased in the inner rings. Tsuga canadensis had no air in this year's wood, only a little in last year's, and an increasing quantity in the older rings, the fifth being very rich in air. In February, Pinus strobus had hardly any air in this year's wood, and the silver fir was all but free from it in the youngest ring. Robinia in July had the youngest wood almost air-free. Ficus elastica and spuria, various acacias and willows gave vessels not entirely free from air, but nearly so. He concludes (loc. cit., p. 688) that the path of the transpiration current is not absolutely free from air. The younger wood, which especially functions as the water carrier, is the most free.

Dixon and Joly quote Strasburger's results, which they consider sufficiently favorable to their views. They rely, in addition, on the impermeability of wet cell walls to air, isolating the conduits in which air has appeared; and on the possibility that the air may be redissolved under root pressure (Phil. Trans., p. 572)—an idea well worth testing.

* He gives reference to Donny, Poggendorff's Annalen, 67 Bd. (143 Bd. d. g. R.), 1846, p. 562; Berthelot, Annales de Chimie et de Physique, S. 3, t. 30, 1850, p. 232; Worthington, Proc. Roy. Soc., vol. l, 1892, p. 423.

† Phil. Trans., vol. 186, p. 570. With ethyl alcohol Worthington records a tension of 17 atmospheres. See Proc. R. Soc., vol. l.

‡ Sachs' "Text Book," edit. iv., Eng. Tr., p. 679, describes evaporation taking place in the cell wall, which makes good the loss by imbibition.

§ Strasburger (Leitungsbahnen, p. 777) observed equilibrium established a good deal quicker.

* Schwendener's experiments, K. Preuss. Akad., 1886, p. 573, do not particularly bear on this question.

† It is possible that the rate of the ascending water is much less than is usually assumed. Thus Schwendener (K. Preuss. Akad., 1886, p. 584) calculates from an observation of v. Höhnel that the transpiration current in the stem of a tall beech was only 2 meters per day.

‡ Pfeffer, "Abhand. der k. Sächs." Ges., xx, p. 300; Eschenhagen, Untersuchungen aus d. Bot. Inst. z. Tübingen, 1889; Stange, Bot. Zeit., 1892.

§ Leitungsbahnen, p. 668 et seq.; Russow in 1883 (Bot. Centr., vol. xiii, 1883) observed similar facts in the distribution of water and air.

I think Strasburger's facts are not so favorable to their theory as these authors believe; in the same way it seems to me that Askenasy is rash in saying* that the tracheals in many cases contain continuous columns of water. It is true that this statement does not affect the validity of his general argument, since he faces the undoubted occurrence of air bubbles in many cases. This is undoubtedly necessary, and, fortunately, we can once more turn to the Leitungsbahnen. Strasburger states that he has seen water creep past the air bubbles (Leitungsbahnen, pp. 704, 709; see also "Hist. Beitr." v, p. 76) in coniferous tracheids. The best evidence for this seems to be the fact mentioned (ibid., p. 70), that the part of a single tracheid in front of an air bubble gets red, with absorbed eosin, though the neighboring tracheids are colorless. This clearly suggests the creeping round the bubble which Strasburger believes in. Schwendener (Zur. Kritik, etc., p. 921) has been unable to confirm Strasburger's microscopic observations, and, moreover, denies the physical possibility of the phenomena. I am unable to judge of the validity of Schwendener's theoretic objections, and must leave this point. It is a question of great importance whether it is possible that, on the breaking of a column of water, a film of water remains surrounding the air bubble, and capable of holding the two columns together. If this is impossible, we must suspend our judgment until we know more of the contents of the tracheals.

To sum up this part of the subject, we may believe that the tracheals in their youngest condition may contain water in continuous columns, since the cambium cells from which they arise certainly contain fluid. But we know also that this condition is not absolutely maintained, since Strasburger has shown that the young wood contains air, though in small quantity. We must, therefore, believe either (1) that the transpiration current is able to travel past the air bubbles, or (2) that tracheals partly filled with air may again become continuous waterways by solution of the air. If we adopt the first alternative, we must believe that the film of water between the bubble and the wall of the vessel is able to bear such a tensile stress that it can serve to link the column above with the column below the bubble. But this is analogous to trusting a rope so nearly cut through that only a few threads remain intact. With regard to the second alternative, we have, at least, indications from Strasburger's work that a tracheal partly filled with air does not necessarily remain permanently functionless (see Leitungsbahnen, p. 692).

The Isolation of the Tracheals.—There are a number of points connected with the structure and properties of wood which ought to be considered in relation to the modern theories. Want of space forbids my doing more than referring to two of them.

The resistance which the wetted cell wall offers to the passage of undissolved air is a point on which many writers have laid stress. It is clear that, on any theory of the movement of water in the tracheals, it is essential that air should not filter into the waterway. This necessity is not, however, stronger in the case of the modern theories we are considering. The pressure tending to fill the tracheals with air from outside cannot be greater than atmospheric pressure and since the wetted cell walls of gymnospermous wood can resist the passage of air under a pressure of about an atmosphere,† we need not fear criticism of the theory on this ground. The above remarks seem, however, to be needed in face of the frequently recurring statement that wet wood membranes are impermeable to free air. Schwendener had some good remarks on this head (Zur Kritik, p. 943).

Strasburger has called attention to the important subject of the localization or isolation of vessels, or of certain lines of tracheids. When this is possible we may have one set of tracheals containing continuous water columns, while neighboring ones contain air at negative pressure (see Histolog. Beiträge, v, p. 87). This is especially important in connection with the Dixon-Joly-Askenasy theory, since if there were no such isolation, a functioning tracheal containing a continuous column of water would give up its water to one which was not functioning. In other words, the inactive tracheals would, by negative pressure, suck water from the active ones. In the coniferous trees the young wood is cut off by the absence of pits in the tangential walls‡ from free communication with the older wood, where air is more frequent.

In the same way the valvelike closure of the pits by the aspiration of the pit membrane comes to be a subject of much importance.

At present I merely wish to show by a couple of examples the necessity of a complete study of the minute structure of wood in relation to the modern theories. It is, at least, a hopeful fact for Messrs. Dixon, Joly and Askenasy that we cannot point to anything in the anatomy of wood which is absolutely inconsistent with their views. Finally with regard to the question at large whether we are friends or opponents of Messrs. Dixon, Joly and Askenasy's theory, the broad facts remain that water has the power of resisting tensile strength, and that this fact must henceforth be a factor in the problem. There are difficulties in the way of our author's theory, but it is especially deserving of notice that many of these difficulties are equally serious in the case of any theory which excludes the help of the living elements of the wood, and assumes a flow of water in the tracheals. The authors have not only suggested a vera causa, but have done so without multiplying difficulties. There is, therefore, a distinct balance in their favor.

Huxley, quoting from Goethe, makes use of the expression thätige Skepsis. It is a frame of mind highly appropriate to us in the present juncture, if we interpret it to mean a state of doubt whose fruit is activity, and if we translate activity by experiment.

Among the metallurgical exhibits at the Scandinavian Exhibition, at present being held in Stockholm, there are some samples of steel billiard balls. These balls, which are made by a secret process out of Mitis cast steel, are hollow, and are claimed to be equal in all respects to ordinary billiard balls.

* Verhand. Naturhist. Med. Vereins Heidelberg, 1896, p. 15.

† Leitungsbahnen, p. 702. Nägeli and Schwendener, Das Mikroskop, 2d edit., p. 367, give 60 cm. of mercury.

‡ Strasburger discusses, in this connection, the existence of tangential pits in the autumnal wood (see Leitungsbahnen, p. 719).

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THE EAST INDIA FRONTIER TROUBLES.

WE present with this article several views of localities in those parts of British East India which have recently been disturbed by native risings.

One of these cuts shows a street in the city of Peshawur, itself at one time in danger of insurrection by its Oriental population. From here troops were sent to the aid of the garrison at Shabkadar, when a band of rebels nearly eight times superior in number to the English came very near forcing these to surrender.

THE INDIAN UPRISING—STREET IN PESHAWUR.

Another place of interest is shown in our fourth illustration. It is the Khyber Pass, which played so important a part in the rebellion. For this and the other engravings we are indebted to Illustrirte Zeitung.

We have also a reproduction from a photograph of some Khyber rifles. These troops the English authorities thought it best to disarm, although no open signs of disloyalty were given. These and other details are, however, well known to our readers through the newspapers, and we do not purpose to dwell upon them at length. Small as may seem the immediate significance of these troubles, they bear upon relations of supreme importance to at least two of the great European powers. We are referring to the position in which Russia and England find themselves to day in Asia. At the end of the last century Anglo-Russian affairs in Asia had a very different aspect from the present state of things. There extended then between them the whole of China on one side, and Turkestan, Persia and Afghanistan on the other. But the year 1796 brought the first of those changes which gradually brought the Russian frontier within a comparatively short distance from English territory. This first step forward by the Russians was invited by request on the part of the King of Georgia for help against the Persians. Catherine the Second, then on the throne, granted the aid, and went further, taking Derbent near the Caspian Sea, Daghestan, and nearly all the land to the river Kur. Georgia was formally placed under Russian protectorate soon after, to be annexed to the great empire. In the early years of the nineteenth century the first step was followed up by the taking from the Turks of the mouth of the river Phasis, and a little later by the annexation of the Persian province of Shirvan, and of Armenia from beyond the Kur to the Aras and Mount Ararat. Thus the barrier of the Caucasian Mountains

was passed by. Besides, these conquests gave the Russians a most advantageous position from which to conduct operations against Turkey in Asia and Persia, and to guard the Caspian Sea and the Black Sea. For years the inhabitants of the mountainous districts held their liberty. But, in the year 1859, Shamyl, the Caucasian hero, after having ruined ten Russian armies, was taken prisoner, and with him fell the cause he had fought for. Thus Russia possessed, south of the Caucasus, eight large provinces, backed on one side by the mountains held by her troops, and protected on the flanks by two seas and strong fortresses. Thus a strong advanced post of the Russian empire was formed, whose center was at Tiflis.

In the meantime the English on their side were also advancing in the opposite direction. In 1816 they compelled the mountain kingdom of Nepaul to acknowledge their supremacy, and two years after Dekhan was reduced to the same dependence. Each of these states received at its royal court an English officer, who watched the king's movements, and at the capital was stationed a British garrison to insure obedience. The pay of this garrison was derived from the taxes levied in certain portions of the king's realm. Thus the English could keep a numerous army without going to any expense.

In 1824 to 1826 two hundred miles of coast in Burma were acquired, the state of Assam became tributary to Great Britain, as did Singapore and Malacca. This made the Gulf of Bengal a British sea, and placed the great commercial road to India and China in the hands of the great colonizing nation.

The next move on the part of Russia was almost directly aimed at the English. The Czar prevailed on his vassal, the King of Persia, to make an attack on Herat, one of the two great cities on the frontier of India and Persia. The first attempt was made in 1833, but without success. Again the Shah sent his troops to Herat four years later, but with the same result. In the next year a third expedition was made, for which the Czar supplied the Persian army with officers, to conduct the siege. England was jealously watching these movements. When the Persian army arrived at their destination, they found the fortress occupied by an English garrison. Forces were also posted in the immediate neighborhood. Against such odds the Shah dared not to continue in his original plans, and he had to retreat. This was in 1838. The event represented a severe check to the Russians. They tried in the following year to make up for the defeat by an attack on Khiva, a town on the second great Indian road. But the army had to cross vast deserts, and nearly all perished on the way.

So far, the English had an indirect advantage. But in 1842 came the Afghan war. Fifteen thousand Englishmen were massacred in the enemy's territory. A new army was sent to avenge the defeat, but it became clear that it was unsafe for the English to venture too far from their peninsula. Since that time it has been their general policy to assume a defensive position, making Herat their outpost, while the Russians have steadily advanced, taking all the most important towns of Turkestan, even Samarkand, one of the ancient Asiatic capitals, and Goukdja, the chief city of Jungarh, which holds some important mountain passes. Thus the two powers, Russia and England, are brought very near each other, and naturally any check received by one is an advantage to the other. It is in this sense that the Indian frontier risings assume a rather important aspect. The Standard speaking of these matters says: "The inner condition of India is not so favorable as that we may with confidence look forward to a costly war at the frontiers."

Just the district where the recent troubles occurred lies at the very point where Russian and English interests meet. Not a hundred miles away the land is the Czar's. These circumstances make the late outbreaks in the far East a link in a chain of events which seems to be gradually moving toward a climax which may prove a point of great issue in the world's history.

To cut glass take a piece of thin, strong thread, soak it with kerosene, methylated spirits or turpentine; then lay it firmly round the portion where the cut is to be made, light the thread and turn the glass so that the flame is below. On pouring water over the glass you will obtain a clean cut where the thread was laid.—Uhland's Wochenschrift.

A TWO WEEKS' TRIP WITH ESKIMO DOGS.*

By the Rt. Rev. JERVOIS A. NEWNHAM, Bishop of Moosonee, B. N. A.

ONE does not generally expect hardship on a seaside trip, yet I expected some. I was to go some fifteen miles down a great river to the bay, then two or three days along the bay, and then ten miles up another big river, and to return the next week the same way. This I have done, traveling for two days each way over the salt water, and yet neither seeing nor smelling it, and traveling over the water by a train! I traveled by train, yet not on wheels, a train which made its own track and did not use fuel or water, and only went at the rate of four or five miles an hour, and only from about 5 A. M. to 2 or 3 P. M. each day. The rest of the time we spent in camp. For those three days and nights we were in the open air, and at what a temperature! Always far below zero, 45 or 50 degrees of frost by day and as much as 60 or 62 at night! A strange seaside trip, surely! But before telling my story, let me explain the above riddle by saying that the "train" was a dog train, composed of a sled drawn by eleven Eskimo dogs, and driven by an "Injun," not an Injuneer—I mean an engineer; and that we traveled over the ice, three feet thick, with two feet of snow on top, which entirely hid the salt water, so that we could only travel by daylight, and had to stop at certain fixed places, where we could find wood for the campfires, and that we slept on the ground, or rather snow, in our cotton tent, or in the wigwams or tents of poles and bark, erected at the regular stopping places.

My home is at Moose Fort, and I wished to visit our mission at Rupert House, confer with the missionary there and see the residents. On the twenty-sixth of February the dogs from Rupert House arrived here and brought me an invitation to return with them,

* From the Independent.

BRITISH ARMY—NATIVE ARTILLERYMEN.

KHYBER RIFLES.

which I gladly accepted, and made my preparations. These consisted in getting suitable food cooked for three or four days, gathering a bundle of blankets and rabbit skin rugs to wrap round me in the sled and sleep on at night, packing a small box with clothes, etc., for use at Rupert House, and looking out my deerskin coat and snowshoes. The food needs to be very simply and ready cooked; for we do not stop during the day to cook, and at night we have to thaw our food, and again in the morning. I took a loaf and some scones, the latter mostly to carry in my pocket and eat at midday; some partridges ready cooked, a little cooked beef and bacon, and a packet of soup powder; also tea and sugar, salt and butter, some frozen cream, frying pan, kettle, cup, plate, etc. Monday, the twenty-second of March, I was up soon after four o'clock, only to find a snowstorm raging, so that I could be down to await developments. At seven o'clock the storm was so heavy that we abandoned the idea of starting that day. The snow fell all day, the worst storm of the season. So we knew we were in for a hard trip.

Tuesday I was up at 3:30, and after a hasty breakfast, donned my "Husky" coat of deerskin with the hair on and started for the dogs. It was a fine morning, but promised to be very cold all day, and the wind right in our teeth. Well, here we are down on the ice, and the dogs all harnessed and impatient to start. Let me describe. The sled consisted of a narrow box four feet long, the front half being covered or

FORT ALI-MUSJID, KHYBER PASS.

boxed in, mounted on a floor eight feet long resting on runners. In this box the passenger sits wrapped in rabbit skin so that he can hardly move, his head and shoulders only projecting. In front and behind and on top of the box is placed all the luggage, covered with canvas and securely lashed to withstand all the jolting and possible upsets, and our snowshoes within easy reach. An important item is the dog whip, terrible to the dogs if used by a skillful hand and terrible to the user if he be a novice; for he is sure to half strangle himself or to hurt his own face with the business end of the lash. The whip I measured had a handle nine inches long and lash thirty feet, and weighed four pounds. The lash was of folded and plaited seal hide, and for five feet from the handle measured five inches round, then for fourteen feet it gradually tapered off, ending in a single thong half an inch thick and eleven feet long. Wonderful is the dexterity with which a driver can pick out a dog, and almost a spot on a dog, with this lash. The lash must be trailing at full length behind, when a jerk and turn of the wrist causes it to fly forward, the thick part first and the tapering end continuing the motion till it is at full length in front, and the lash making the fur fly from the victim. But often it is made to crack like a pistol over the heads of the dogs as a warning. The eleven dogs were harnessed to the front of the sled, each by a separate thong of seal hide, all of different lengths, fastened to a light canvas harness. The nearest dog was about fifteen feet from the sled and the leader with bells on her about fifty feet, the thongs thus increasing in length by about three feet. When the going is good the dogs spread out like the fingers of a hand, but when the snow is deep they fall into each other's tracks in almost single file. As they continually cross and recross each other, the thongs get gradually plaited almost up to the rearmost dog, when a halt is called, the dogs are made to lie down, and the driver carefully disentangles them, taking care that no dog gets away meanwhile. They are guided by the voice, using "Husky," i. e. Eskimo words: "Owk!" go to the right, "Arrah!" to the left, and "Hoit!" straight on. But often one of the men must run ahead on snowshoes for the dogs to follow him. See me now in my box, carefully wrapped up, all but my face, in blanket of plaited rabbit skins, a jerk is given to the sled to loosen it, "Hoit!" and we are off! I have often seen the dogs start at a gallop of six miles an hour; but the snow is deep and we go at a slow trot, the men running and helping the dogs. It is slow and cold for me, but gradually Moose Fort is left behind as we go down the river.

At eleven o'clock we halt ten minutes for refreshments. We are in no anxiety lest the train will start before our coffee has cooled enough for us to drink it; our hurry is lest it and the sandwich should freeze before we consume them. An al fresco lunch sounds very charming, but there are decided drawbacks. Standing or sitting with fifty degrees of frost, the mustache and beard heavily laden with icicles, so that it is difficult to open the mouth without bringing tears to the eyes, by reason of the hairs pulled out, the fingers freezing if they are kept out of the mittens for a few minutes for eating purposes, the bread frozen, or beginning to freeze the moment it is taken from the pocket—these are not the best constituents for a picnic. We never stop to cook in the middle of the day's journey; but a jar of boiling tea has been stowed in the blankets, and has not lost all its warmth, and a sandwich or a scone carried in an inner pocket will not be frozen very hard. On again, and at 1 P. M. we are passing Natatishe Point, twenty-two miles from Moose. We reach the next point, Big Stone, before three o'clock; but as it was twenty-five miles to the next possible stopping place, we had to be content to go no further that day. We had a cotton tent with us, and a small portable stove, and the first thing was to erect these in the shelter of the bush, and to get some wood for the fire. This took some time, and I found the waiting miserably cold work, chilling me to the bone. Of course the floor of our tent, which is also our bed, is the trampled surface of snow, with a few pine branches laid on top. When the fire in the stove was burning my bedding was laid in the tent, and, sitting on this, I proceeded to unpack and thaw my food and to thaw myself. The stove had not been very well put up, and kept up a constant leakage of most pungent smoke, which soon caused me real agony in the eyes. My supper of bread and butter and a bird, ready cooked, needed only to be thawed, and water to be boiled for tea, but the thawing takes long, and it was half past four before it was ready. I also found that partridge shot in December, frozen till March, then cooked and frozen again, thawed and so eaten, is rather dry and uninteresting food. The men were busy cutting dry firewood, attending to the dogs and cooking their supper till later than this. The dogs are unharnessed and chained to trees, out of reach of each other, as they are very quarrelsome, and presently fed with frozen fish, rabbits, or seal blubber, as the case may be. They sleep in the snow, coiled up without any shelter, and get very little attention. A tent with a stove is more comfortable for us than the open wigwam fire in the middle, which is always very bad for smoke. The cotton tent gets almost too hot while the stove is in full draught; but everything in it, except the sleepers, freezes solid at night. It was too smoky for comfort, so as we had to get up very early, we lay down at eight o'clock. My bedstead was snow, mattress pine branches, bed of rabbit skin and blanket of ditto. I have learned to sleep like an Indian, with head under the blanket; but even so, one gets very cold before midnight, and that and the hard bed made my rest very much broken. I think that the men must have lit the fire very early next morning. About three o'clock I awoke (indeed, I awoke several times before that, owing to the hardness of the bed and the cold), and put all my breakfast materials to thaw; but did not get up finally till four o'clock. It took us till six to thaw or cook our breakfast and eat it, so that we did not start till 6:30.

The day was fine for us, but the snow was deep and soft, making heavy traveling. It was also cut into a succession of ridges by the winds; so that it was like crossing a plowed field diagonally. It was hard on the dogs, hard on the passenger, if he rode, owing to the constant bumping of the sleigh, and very awkward snowshoeing over the ridges. The drivers had to walk the whole way, and I walked for an hour. I had come with borrowed snowshoes, which were too short and tight at the toes, so that I was sore and lame after half an hour. However, I managed two hours' more tramp after lunch, at 10:30, and we reached East Point at noon. It was too late to go on to the next camp (twenty miles at least), so we made for the tent here and were in it by 2 P.M.; very early to stop, but there was no help for it. Here we used the "tent," i. e., not our cotton markee, but a fixture of logs and poles and boughs, about fourteen feet in diameter, and open at the top, through which opening the smoke is supposed to go. One was roasting on the side near the fire, and freezing on the further side. The smoke was dreadful, and very painful to my eyes; I could hardly read prayers for the pain and tears, and was glad to turn into bed at eight o'clock. It was a very cold night (about 65 degrees of frost, or 33 below zero), but I slept fairly well, only felt a little rheumatic and sore from the hard, cold ground. Awaking in the night, I found the hair on my forehead stiff with ice from my breath, and pillow and blankets ditto. Thursday, up at four o'clock and off at 6:15. A bitter morning, and I found the cold while preparing to start almost unbearable; but I got right under my sleigh-robes and dozed. We had to cross two or three small bays, about twenty miles to Cabbage Willows. When half way across an Indian came out to meet us. He reported "no rabbits, and family starving," i. e., very hungry; so we gave him some food from our small store. We found out afterward that he makes a regular business of stopping people passing with the same story, they being a lazy, shiftless lot. Reaching Cabbage Willows at 1 P. M., we determined to press on. Then came the hardest bit of all. Here the snow had drifted to a great depth; all had to walk, one man tramping a path for the dogs, which fell into single file, the leader being almost hidden in the snow. The second man and I walked by the sled, holding it up, and often helping to push it when the dogs stuck fast.

We reached Black Bear Point at six o'clock and hastened to get tent fixed, wood cut, etc., before dark. We used our cotton tent and the stove here; the wood was rather green, and it took a long time to get the stove to burn and the food to thaw. The night and next morning were passed as before, only that we got up about 3 A. M., and made an early start. It still kept cold with a strong wind in our faces, so that, but for a short walk, I kept down under the blankets. About 9 A. M. we stopped to disentangle the dogs for the last time, and the leader was stripped of her harness and robed in a set gay with ribbons and colored wools, in which to arrive at the place. Directly after this we rounded a point and saw Rupert House a few miles off and knew that they would at once see us. But it was a tedious two hours before we arrived. Rupert House is prettily situated on a high bank of the river, much higher than anything we have round flat Moose Fort. I forgot to say that all the morning and part of the day before we had in sight, far to the north, Sherrick's Mount, a really high hill, and the only hill to be seen for many days' journey round Moose. A gang of men and boys came down the bank and gave the dogs a help up it, so that we arrived in style, on the run, with a great team, human and canine, to receive a most hearty greeting from Mr. M., in charge of the post. On a journey like this toilet exercises are of the most meager kind, and undressing is not practicable; so the first thing to do was to get out of my deerskin coat, which was always shedding its hairs over everything, including my food, and then to have a good wash and thorough change. I cannot now tell of my pleasant stay at Rupert House, visiting everybody, whites and Indians, holding services in the church, and enjoying the rest and the visit generally, but must pass on to my return, which I must dismiss with a few lines. The weather was fine while I was at Rupert House, and a high wind blowing all the time, so we expected the snow to be well packed and make the return journey easier. I had the Rev. E. R., native missionary, and his man with me this time as my crew, and they were naturally not as expert at camping arrangements as the men I had before. Also instead of eleven good dogs I had only eight second-rate; so I did not expect to make such good time. The route was the same as that by which we came, but the division of it different. We started at 7 A. M., and managed to reach Cabbage Willows before dusk. Here is a fixed tent which we used instead of our cotton one. It was a mistake, for it needed more wood, which we had to cut, was very cold, and was

the worst for smoke so far. However, we managed somehow. My present crew were early risers, or we should not have reached home as soon as we did. They had the fire going by two o'clock, and I was up by three; but they were so slow over their preparations that it was after six when we started. I was up each morning by three at the latest, but we only once got off before six; yet I was afraid to lie on, lest they should do the same, and we should be later still.

The second day we only reached East Point; the third, by starting earlier and traveling later, we passed Bigstone without stopping and camped at Natatishe Point. Somehow on the second day I sprained the sinews of my right hand, which swelled very much and became very painful and continued so all the journey. At Natatishe we used our markee and camped very luxuriously on top of a hard snowdrift four feet deep. The fourth day we started early and hoped to reach Moose before noon. But traveling was hard and dogs tired, and we had a tedious time. I tramped a good bit of the way. So we struggled along, getting our dogs into a run here and there, where the snow was not deep, past Pilgrims, the tail of our island, the servants' houses, the factory, along the ox-track, and then a scramble up the bank and through the gap in the fence into our field at the side of the house and so at home just as the Indian children were going into afternoon school at two o'clock. Thus ended my first dog trip. Some fun, some discomfort at least, toes frostbitten, nose and cheeks peeled from the sun and frost, well tanned, and with a fresh stock of health and appetite.

THE GROTTO OF LA BALME.

ALTHOUGH it is annually visited by about 4,000 tourists, most of whom come from Lyons, the Grotto of La Balme, of which we reproduce herewith a few photographic views sent us by M. Boissonnas, the well known artist photographer, does not as yet possess all the reputation that it merits. It is situated in the department of the Isère, at about four miles from the station of Lagnieu and in the immediate vicinity of the pretty little village of La Balme, where one easily finds for hire the change of clothing, lamps and guides that are

FIG. 2.—BACK OF THE LAKE GALLERY.

necessary for visiting it without danger. The grotto, which is hollowed out in a low Jurassic chain, is spacious, easy of access and remarkably dry in all its galleries, save at the epochs in which its lake overflows as a consequence of prolonged rains. It was, of old, a place to which religious pilgrimages were made, and at present contains enough natural curiosities to attract even those whose æsthetic or scientific sense is alone developed. We shall speak of it from this view point solely.

The entrance of the grotto is immense, "one of the grandest known," as M. Martel asserts in his book entitled "Les Abîmes." It is 100 ft. in height and 68 in width. Unfortunately, its aspect is marred by a chapel dedicated to the Virgin, the stairway of which intersects this vast opening transversely and diminishes the artistic effect of it. Back of the chapel, the vault of the grotto is about 50 ft. higher still, so that the visitor finds himself in an immense chamber (the grand nave), decorated with calcareous concretions, whence he can enter the three main passageways, each of which presents an ensemble of peculiar characters. The one to the left, which is quite narrow at its origin, leads to Mandrin's Labyrinth, so called because the notorious brigand of that name took refuge therein at various times and even established there, it is said, a workshop for the manufacture of counterfeit money.

Several tortuous galleries, connected with each other and intersected by cavities in the form of chambers, justify the name of labyrinth given it in the vicinity.

The central gallery, which is wider than the preceding, and is no less uneven, affords a passage for the water which proceeds from an overflow of the lake, and which flows in a torrent over the irregular bottom, in which are hollowed out huge pot holes, multiform basins and fissures wherein the water accumulates, and along the edge of which it is prudent to walk slowly in order to avoid disagreeable duckings.

Quite near the entrance are situated the Grotto of Diamonds, in which hundreds of stalactites sparkle in the light of Bengal fires, and the Basin Amphitheater, wherein there is a succession of superposed bowls which empty their contents one into another and, at the time of high water, form superb cascades. The lake, which occupies the back of this gallery, results from the union of the waters that have infiltered from the summit of the mountain and perhaps also from other and unknown sources.

Bourrit, its first explorer, in the last century, unhesitatingly plunged into it, and, pushing before him as he swam a float upon which candles were fixed, prolonged his excursion to a point at which the low ceiling presented a barrier to his further progress. Such prowess, which has become legendary, would be perfectly superfluous to-day, since a small boat permits the traveler to traverse the lake from one end to the other, and to admire the limpidity of its water and the curious conformation of the ceiling that surmounts it. Such a trip is impressive and cannot be too highly recommended.

As for the passageway to the right, that rises quite rapidly through rocks that have fallen as far as to the Monk's Chamber, one of the most spacious of the entire grotto. This chamber is a wonder. It is strewed with concretions of the most diverse shapes, and upon its floor there rests a huge stalagmite, 10 ft. in height, the

FIG. 1.—THE MONK'S CHAMBER IN THE GALLERY OF BATS.

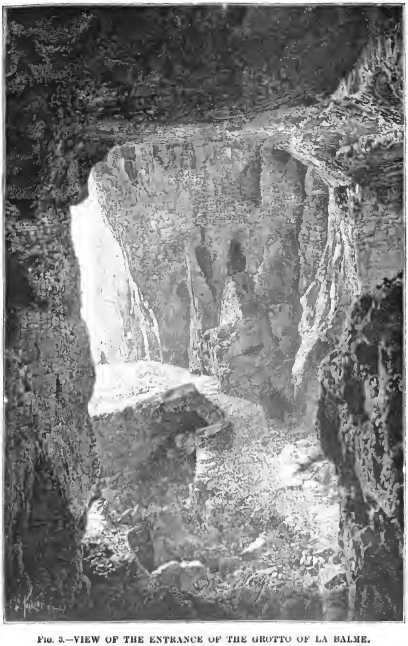


FIG. 3.—VIEW OF THE ENTRANCE OF THE GROTTO OF LA BALME.

form of which somewhat recalls that of a monk, and which is surrounded by other and similar mamelons that have been continuously enlarged by the falling of water, drop by drop, from the vault. From the reproductions of the photographs that we give may be seen the effect produced in this chamber by the play of the light from a powerful magnesium lamp, the rays of which penetrate to the most distant corners. At a few yards further along is found the great fountain, which is formed of an assemblage of basins in which water is in constant circulation and in the center of which stands a magnificent column formed of the union of a stalactite with a stalagmite measuring nearly 5 ft. in diameter.

In retracing our steps in order to reach the great nave, the starting point of these main galleries, we may visit a strange collection of tortuous excavations communicating with each other by narrow fissures. This is the labyrinth of Francis I, in the center of which there is a sort of natural saloon in which the king had a breakfast served at the time of his visit to the grotto.

We have no intention of describing in detail this remarkable cavern, which ought to be known to all speleologists, and to which M. Martel devotes a simple note in his classical work. The concretions that project from its walls have, in places, forms that recall certain organic structures (a beehive, a recumbent lion, a weeping willow, a toadstool, a swallow's nest, etc.), and the conformation of the pot holes, basins and ladders furnishes valuable indications as to the manner in which the grotto was fashioned. Let us be content to add that it requires at least three hours to explore it, and that M. E. Chantre, the learned archeologist of Lyons, has found therein vestiges of human industry, although at the present time it is inhabited only by bats and spiders.—La Nature.

HIBISCUS MANIHOT—FLOWERS SULPHUR-YELLOW, DEEP PURPLE EYE.

HIBISCUS MANIHOT.

EITHER this is a very variable plant, or several species are confused with it. The plant shown by Mr. Fulford, gardener, Moor Hall, Cookham, at Drill Hall, on September 7, 1897, and certificated by the Royal Horticultural Society, differed widely from the plant grown in the temperate house at Kew under this name. Nor is the Kew plant annual, the example under notice being about ten years old. It is cut down early in spring, and by the autumn it makes shoots 6 feet or so high, as thick as a man's finger, and it develops terminal and axillary racemes of flowers in September, being finely in flower now. The largest leaves have petioles 18 inches long, a pedately-lobed blade 18 inches across, the lobes irregularly notched or toothed. Both petiole and blade are [thinly] clothed with soft, very fine hairs. In habit and leaves the plant resembles a vigorous castor oil plant, save that it is of a uniformly dark green color. The flowers are fully 6 inches across, their color being clear sulphur yellow, with a maroon eye-like blotch at the base. The peduncle is 2½ inches long; the calyx lobes, of which there are four, are over an inch long, by three-quarters of an inch broad at the base. The flowers last only a day or so, but they are borne in large numbers and in quick succession. For a large greenhouse this plant is worth attention. It is ornamental even when not in flower. It thrives better when planted in a border than when grown in a pot. —W. W.

[We believe that this is a very variable plant, and it is possible that some might consider more than one species included under the same name. That is not our view, nor has the inspection of the plant growing in the temperate house shaken our conclusion. The species seems distributed throughout the tropics of the Old World, but whence it originated is not clear. It is said to have been introduced from China, but the species is not enumerated in Forbes' and Hemsley's enumeration of Chinese plants. In the monograph of Malvaceæ, contributed to the Flora of British India by the present writer, it is not recognized as a wild Indian plant (see vol. i, 1875, p. 341). It is not mentioned in Roxburg's Flora Indica, nor in the Flora of Tropical Africa, nor in Mr. Baker's Flora of Mauritius, nor in Grisebach's Flora of the West Indies. On the contrary, it is included as a native plant in Franchet and Savatier's Enum. Plant. Japon. (1875), i, p. 64, and in the Flora of Queensland (Bentham Flora Aust., i, 209). Linnæus, of course, could not have known of this locality. Probably a search through some of the pre-Linnæan books might afford some information, and also give the explanation of the name Manihot, also applied to a Euphorbiaceous genus. Evidently there are some interesting historical details to be unearthed when time and opportunity permit. In the meantime, we can all admire the loveliness of the flower, and although it is of no use for cutting, few things confer greater beauty on the warm greenhouse. We hope Mr. Watson will contrive to fertilize the flower, and secure perfect seed for botanical, as well as for cultural, purposes. It has been cultivated in this country, according to The Botanical Magazine, since 1712, at which period it was sent to the Royal Society as one of the fifty specimens then required to be delivered annually to that Society by the Society of Apothecaries.—ED.]—The Gardeners' Chronicle.

THE CAPRICES OF ORCHIDS.

THE family of plants known as orchids present many anomalies puzzling to botanists. Most of them cannot seed unless some insect or bird assists in effecting fertilization. As a consequence of having the work done through agents, it generally goes undone. Of every thousand of orchid flowers, a very small portion ever perfect seed. But even this seems to have been anticipated, for when a seed vessel does mature, the seeds are as the sands of the sea shore in number, and they are as small and as light as dust; though only one capsule in a large forest should mature, the whole forest area would be stocked full of plants did the seeds grow. But here again comes in a sort of contradiction, for the seeds seem to grow but rarely.

In our own country it has been noted that one of the slipperworts (Cypripedium acaule) usually produces a few seed vessels that mature early. Yet only about the same number of plants are found from year to year as were originally observed in the location. The seeds are widely distributed, but do not grow. The skillful horticulturist, however, makes the seed grow very easily at his bidding.

With a little practice he can get every one to grow as easily as beans. They require, he finds, a very nice combination of conditions to germinate—conditions that are rarely found in a state of nature. The curious question arises, Why should Nature make such complex arrangements with such small results? But here again there seems to be a foreknowledge that these intricate arrangements may fail, and a provision is made for defense by giving them a high power of endurance. None of them are annuals, and they are so constructed that neither an excess of heat nor moisture endangers their existence. They will stay for months dormant under long continued heat and drouth, and push forth at once in all the glory of their showy flowers and luxuriant leaves as soon as a few warm showers come. But the inconsistency of their characters is one of their most striking marvels.

In some parts of the world, especially in Australia, a plant that has long borne flowers of a certain genus and species will, of a sudden, exhibit flowers and foliage of what had hitherto been regarded by botanists as of a totally different genus, and it seems like a stroke of the magic art to have these many different structures proceed from the same individual. In the same line, the hybridist enters the field with his orchid wonders. He finds that what science has told him are distinct genera will cross fertilize, and the product be a race of orchids for which distinct generic names have to be coined. What is more remarkable is that these hybrids, from these distinct genera, are as abundantly fertile as their parents, and the hybrid characters are produced and reproduced by the progeny of the hybrid parent just as perfectly as a normal species fertilized by its own pollen. In fact, no orchid grower despairs of producing hybrids between any species or genera. He will tell us that success or non-success is merely a matter of experiment. Continually the most surprising combinations are announced. One of the most recent successes is between two genera comparatively common in our greenhouses and conservatories. One is the purple butterfly orchid (Zygopetalum Mackayi), the other the tooth-tongued orchid (Odontoglossum crispum). The contrary behavior of orchids in these various stages of life is proving a great strain on botanical science. It seems impossible to arrange them into genera and species under any system that will prove of stability. The fecundation of orchids by artificial means is so easy that many amateur growers are finding in it a new source of floral gratification. The little beak-like cap at the apex of the column of stamens and pistils is pushed off, and the pollen masses exposed. These are placed on the stigma, and the work is done. The interest is in the form of the capsules that follow. In the case above cited, the purple butterfly orchid, a pear-like seed vessel, as large as the upper segment of a large thumb, follows, and not only this, but the petals of the orchid get a renewed lease of life by the operation. Instead of falling a few days after expansion, they erect themselves, and give some interest for a month or more.—Independent.

THE BEGINNINGS OF AMERICAN ASTRONOMY.*

IT is impossible, even in the briefest sketch, not to emphasize the debt of American science and learning to the intelligent interest and patronage of our early presidents—Washington, John Adams, Jefferson, Madison, Monroe, John Quincy Adams. The powerful impetus given by them and through them has shaped the liberal policy of our governments, national and State, toward education and toward science. Sir Lyon Playfair, in his address to the British Association for the Advancement of Science (1885), has recognized this influence in the truest and most graceful way. He said: "In the United Kingdom we are just beginning to understand the wisdom of Washington's farewell address to his countrymen (1796) when he said: 'Promote, as an object of primary importance, institutions for the increase and diffusion of knowledge; in proportion as the structure of a government gives force to public opinion, it is essential that public opinion should be enlightened.'"

Until the Revolution (1776) American science was but English science transplanted, and it looked to the Royal Society of London as its censor and patron. Winthrop, Franklin and Rittenhouse were, more or less, English astronomers. Franklin was the sturdiest American of the three. As early as 1743 he suggested the formation of the American Philosophical Society, of Philadelphia. John Adams founded the American Academy of Arts and Sciences in Boston in 1780. These two societies, together with Harvard College (founded in 1636), Yale College (1701), the University of Virginia (founded by Jefferson in 1825) and the United States Military Academy at West Point (1801), were the chief foci from which the light of learning spread. Other colleges were formed or forming all over the Eastern and Middle States during the early years of the century.

The leading school of pure science was the Military Academy at West Point, and it continued to hold this place until the civil war of 1861. From its corps of professors and students it gave two chiefs to the United States Coast Survey; and the army, particularly the corps of engineers, provided many observers to that scientific establishment, besides furnishing a large number of professors and teachers of science to the colleges of the country. The observatory of the academy was founded by Bartlett, in 1841, and much work was done there, only a small part of which is published. The Coast Survey was a school of practice for army officers, and their experience was utilized in numerous boundary surveys during the period 1830-50. Col. J. D. Graham, for example, was astronomer of the survey of the boundary between Texas and the United States in 1839-40; commissioner of the northeast boundary survey, 1840-43; astronomer of the northwest boundary survey, 1843-47; of the boundary between the United States and Canada, 1848-50; of the survey of the boundary between Pennsylvania and Virginia, 1849-50; of the boundary survey between Mexico and the United States, 1850-51. The names of Bonneville, Talcott, Cram, Emory and other army officers are familiar in this connection, and their work was generally of a high order. It was in such service that Talcott invented or reinvented the zenith telescope, now universally employed for all delicate determinations of latitude. The mechanical tact of Americans has served astronomy well. The sextant was invented by Thomas Godfray, of Philadelphia, in 1730, a year before Hadley brought forward his proposal for such an instrument.† The chronograph of the Bonds, the zenith

* From Science.

† In 1700 Sir Isaac Newton sent drawings and descriptions of a reflecting sextant to Halley for his advice. At Halley's death these were found among his papers. Hadley's device (1731) was undoubtedly derived from Newton's MSS. The Royal Society, of London, granted £200 to Godfray for his invention, which his brother, Capt. Godfray, had previously put into practical use in the West Indies.

telescope of Talcott and the break circuit chronometer of Winlock are universally used to-day. The diffraction gratings of Rutherfurd were the best to be had in the world till they were replaced by those of Rowland. The use of a telescope as a collimator was first proposed by Rittenhouse. The pioneer opticians of the United States were Holcomb (1826), Fitz (1846 or earlier), Clark (1845), Spencer (1851). Only the Clarks have a world-wide reputation. Würdemann, instrument maker to the United States Coast Survey (1834), had a decided influence on observers and instrument makers throughout the United States, as he introduced extreme German methods and models among us, where extreme English methods had previously prevailed. The system of rectangular land surveys which proved to be so convenient for the public lands east of the Rocky Mountains was devised and executed by Mansfield, a graduate of the Military Academy.

The list of army officers who became distinguished in civil life as professors in the colleges of the country is a very long one. Courtenay (class of 1821 at West Point) was professor of mathematics at the University of Pennsylvania, 1834-36, at the University of Virginia, 1842-53, and was the author of admirable text books. Norton (class of 1831) became professor at New Haven, and wrote a very useful text book of astronomy in 1839; and the list could be much extended. The excellent training in mathematics at West Point (chiefly in French methods) early made itself felt throughout the whole country. The mathematical text books of Peirce, of Harvard, and of Chauvenet, of the Naval Academy, brought the latest learning of Europe to American students. Mitchell (class of 1829 at West Point) was the only graduate who became a professional astronomer (1842-61). His direct service to practical observing astronomy is small, but his lectures (1842-48), the conduct of the Cincinnati observatory (1845-59), and his publication of the Sidereal Messenger (1846-48), together with his popular books, excited an intense and widespread public interest in the science, and indirectly led to the foundation of many observatories. He was early concerned in the matter of using the electric current for longitude determinations, and his apparatus was only displaced because of the superior excellence of the chronograph devised by the Bonds. His work was done under immense disadvantages, in a new community (Ohio), but the endowment of astronomical research in America owes a large debt to his energy and efforts.

The Navy and the United States Naval Academy (founded by Bancroft in 1845, at the suggestion of Chauvenet) were very active in astronomical work. Chauvenet (Yale College, 1840) published a text book of trigonometry, in 1850, which had an important share in directing attention to right, elegant and general methods of research. His astronomy (1863) is a handbook for all students. Walker, Gilliss, Coffin, Hubbard, Ferguson, Keith, Yarnall, Winlock, Maury, Wilkes, were all connected with the navy, more or less intimately. Walker's career was especially brilliant; he graduated at Harvard College in 1825, and established the observatory of the Philadelphia High School in 1840. He was the leading spirit in the United States Naval Observatory at Washington (1845-47) and introduced modern methods into its practice at the beginning. From the observatory he went to the coast survey to take charge of its longitude operations, and he continued to direct and expand this department until his death, in 1853. To him, more than to any single person, is due the idea of the telegraphic method ("the American method") of determining differences of longitude. His assistant in this work was Gould, who succeeded to the charge of it in 1853. His researches extended to the field of mathematical astronomy also, and his theory of the planet Neptune (then newly discovered) marks an important step forward. His investigations and those of Peirce were conducted in concert and attracted general and deserved attention.

The exploring expedition of Wilkes required corresponding observations to be made in America, and during the period 1838-42 William Bond, at Dorchester, and Lieutenant Gilliss, at Washington, maintained such a series with infinite assiduity and with success. The results of Gilliss' astronomical expedition to the southern hemisphere (Chile, 1849-52) were most creditable to him and to the navy, though his immediate object—the determination of the solar parallax—was not attained.

The Coast Survey began its work in 1817 under Hassler, a professor from West Point, who impressed upon the establishment a thoroughly scientific direction. Bache, his successor (a grandson of Benjamin Franklin), was a graduate of West Point in the class of 1825, and took charge of the survey in 1843. He is the true father of the institution, and gave it the practical efficiency and high standard which characterized its work. He called around him the flower of the army and navy, and was ably seconded by the permanent corps of civilian assistants—Walker, Saxton, Gould, Dean, Blunt, Pourtales, Boutelle, Hilgard, Schott, Goodfellow, Cutts, Davidson and others.

Silliman's (& Dana's) American Journal of Science had been founded at New Haven in 1818, and served as a medium of communication among scientific men. A great step forward was made in the establishment of the Astronomical Journal by Dr. Gould on his return from Europe at the close of 1849.* Silliman's Journal was chiefly concerned with the non-mathematical sciences; though it has always contained valuable papers on mathematics, astronomy and physics, especially from the observers of Yale College—Olmsted, Herrick, Bradley, Norton, Newton, Lyman and others. In Mason, who died in 1840 at the age of 21, the country lost a practical astronomer of the highest promise.† Gould's Journal was an organ devoted to a special science. It not only gave a convenient means of prompt publication, but it immediately quickened research and helped to enforce standards already established and to form new ones. The Astronomical Notices of Bruennow (1858-62) might have been an exceedingly useful journal with an editor who was willing to give more attention to details, but, in spite of Bruennow's charming personality and great ability, it had comparatively little influence on the progress of the science.

* The Astronomische Nachrichten had been founded in Altona, by Schumacher, in 1821.

† See International Review, vol. x. p. 565.

The translation of the Mécanique Céleste of Laplace by Nathaniel Bowditch, the supercargo of a Boston ship (1815-17), marks the beginning of an independent mathematical school in America. The first volume of the translation appeared in 1829; at that time there were not more than two or three persons in the country who could read it critically. The works of the great mathematicians and astronomers of France and Germany — Laplace, Lagrange, Legendre, Olbers, Gauss, W. Struve, Bessel—were almost entirely unknown.

Bowditch's translation of the Mécanique Céleste, and, still more, his extended commentary, brought this monumental work to the attention of students and within their grasp. His Practical Navigator* contained the latest and best methods for determining the position of a ship at sea, expressed in simple rules. American navigators had no superiors in the first half of the century. Nantucket whalers covered the Pacific, Salem ships swarmed in the Indies, and the clipper ships made passages round the Horn to San Francisco which are a wonder to-day. Part of their success is due to the bold enterprise of their captains (who were said to carry deckloads of studding sail booms to replace those carried away!) but an important part depended on their skill as observers with the sextant. One of the sister ships to the one of which Bowditch was supercargo was visited at Genoa by a European astronomer of note (Baron de Zach), who found that the latest methods of working lunar distances to determine the longitude were known to all on board, sailors as well as officers. His bewilderment reached its climax when the navigator called the negro cook from the galley and bade him expound the methods of determining the longitude to the distinguished visitor.

On Bowditch's own ship there was "a crew of twelve men, everyone of whom could take and work a lunar observation as well, for all practical purposes, as Sir Isaac Newton himself." Such crews were only to be found on American ships in the palmy days of democracy. All were cousins or neighbors, and each had a "venture" in the voyage. But these anecdotes may serve as illustrations of the intellectual awakening which came about as soon as our young country was relieved from the pressure of the two wars of 1776 and 1812. An early visitor, Baron Hyde de Neuville (1805), felt "an unknown something in the air," "a new wind blowing." This new spirit, born of freedom, entered first into practical life, as was but natural; science next felt its impulse, and, last of all, literature was born. Emerson hailed it (in 1837) "as the sign of an indestructible instinct." "Perhaps the time is already come," he says, "when the sluggard intellect of this country will look from under its iron lids and fill the postponed expectation of the world with something better than the exertions of mechanical skill. Our day of dependence, our long apprenticeship to the learning of other lands, draws to a close. The millions that around us are rushing into life cannot always be fed with the sere remains of foreign harvests."

Benjamin Peirce a graduate of Harvard in the class 1829, had been concerned with the translation of the Mécanique Céleste, and was early familiar with the best mathematical thought of Europe. He became professor in Harvard College in 1833, and after the death of Bowditch, in 1838, he was easily the first mathematical astronomer in the country. His instruction was precisely fitted to develop superior intelligences, and this was his prime usefulness. Just such a man was needed at that time. Besides his theoretical researches on the orbits of the planets (specially Uranus and Neptune) and of the moon, his study of the theory of perturbations, and his works on pure mathematics and mechanics, he concerned himself with questions of practical astronomy, although the observations upon which he depended were the work of others. He was the consulting astronomer of the American Ephemeris and Nautical Almanac from its foundation in 1849, and its plans were shaped by him to an important degree. His relative, Lieutenant Davis, United States Navy (the translator of Gauss' Theoria Motus Corporum Coelestium, 1857), was placed in charge of the Ephemeris, and the members of its staff—Runkle, Ferrel, Wright, Newcomb, Winlock and others—most effectively spread its exact methods by example and precept. Professor Peirce undertook the calculations relating to the sun, Mars and Uranus in the early volumes of the Ephemeris. As a compliment to her sex, Miss Maria Mitchell was charged with those of Venus; Mercury was computed by Winlock, Jupiter by Kendall, Saturn by Downes, Neptune by Sears Walker.

The Smithsonian Institution was founded in 1846, and Joseph Henry was called from Princeton College to direct it. There never was a wiser choice. His term of service (1846-78) was so long that his ideals became firmly fixed within the establishment and were impressed upon his contemporaries and upon a host of younger men. The interests of astronomy were served by the encouragement of original research through subsidies and otherwise, by the purchase of instruments for scientific expeditions, by the free exchange of scientific books between America and Europe, and by the publication of the results of recondite investigations. It is by these and like services that the Institution is known and valued among the wide community of scientific men throughout the world.

But this enumeration of specific benefits does not convey an adequate idea of the immense influence exercised by the Institution upon the scientific ideals of the country. It was of the first importance that the beginnings of independent investigation among Americans should be directed toward right ends and by high and unselfish aims. In the formation of a scientific and, as it were, a moral standard a few names will ever be remembered among us; and no one will stand higher than that of Henry. His wise, broad and generous policy and his high personal ideals were of immense service to his colleagues and to the country.

The establishment of a national observatory in Washington was proposed by John Quincy Adams in 1825; but it was not until 1844 that the United States Naval Observatory was built by Lieut. Gilliss, of the Navy, from plans which he had prepared. By what seems to have been an injustice Gilliss was not appointed to be its first director.* This place fell to Lieut. M. F. Maury. Gilliss had been on detached service for some years, and a rigid construction of rules required that he should be sent to sea, and not remain to launch the institution which he had built and equipped.

* First edition, 1802. Sumner's method in navigation (1843) a very original and valuable contribution from a Boston sea captain, and Maury's Wind and Current Charts, begun in 1842, are two other notable contributions from a young country to an art as old as commerce.

The first corps of observers at Washington (1845) contained men of first class ability—Walker, Hubbard, Coffin. Gilliss' work as astronomer to Wilkes Exploring Expedition (1838-42), at his little observatory on Capitol Hill, had shown him to be one of the best observers, as well as one of the most assiduous. His study and experience in planning and building the Naval Observatory had broadened his mind. To the men just named, with Peirce, Gould and Chauvenet, and to their coadjutors and pupils, we owe the introduction of the methods of Gauss, Bessel and Struve into the United States, and it is for this reason that American astronomy is the child of German, and not of English science.

The most natural evolution might seem to have been for Americans to follow the English practice of Maskelyne and Pond. But the break caused by the war of independence, by the war of 1812, and by the years necessary for our youthful governments to consolidate (1776-1836) allowed our young men of science to make a perfectly unbiased choice of masters. The elder Bond (William Cranch Bond, born 1789, director of Harvard College Observatory, 1840-59) was one of the older school and received his impetus from British sources during a visit to England in 1815.

In estimating the place of the elder Bond among scientific men, it is necessary to take into account the circumstances which surrounded him. He was born in the first year of the French revolution (1789); he was absolutely self-taught; practically no astronomical work was done in America before 1838. When Admiral Wilkes was seeking for coadjutors to prosecute observations in the United States during the absence of his exploring expedition, he was indeed fortunate in finding two such men as Bond and Gilliss. Their assiduity was beyond praise, and it led each of them to important duties. Bond became the founder and director of the observatory of Harvard College, while Gilliss is the father of the United States Naval Observatory at Washington, as well as of that of Santiago de Chile, the oldest observatory in South America. Cambridge, though the seat of the most ancient university in America, was but a village in 1839. The college could afford no salary to Bond, but only the distinction of a title, "Astronomical Observer to the University," and the occupancy of the Dana house, in which his first observatory was established. His work there, as elsewhere, was well and faithfully done, and it led the college authorities to employ him as the astronomer of the splendid observatory which was opened for work in 1847. At that time the two largest telescopes in the world were those of the Imperial Observatory of Russia (Pulkova) and its companion at Cambridge. Each of these instruments has a long and honorable history. Their work has been very different. Who shall say that one has surpassed the other? We owe to Bond and his son the discovery of an eighth satellite to Saturn, of the dusky ring to that planet, the introduction of stellar photography, the invention of the chronograph, by which the electric current is employed in the registry of observations, the conduct of several chronometric expeditions between Liverpool and Boston to determine the transatlantic longitude, and a host of minor discoveries and observations.

Gilliss visited France for study in 1835, before he took up his duties at Washington. The text books of Bond and Gilliss were the astronomies of Vince (1797-1808) and of Pearson (1824-29). The younger Bond (George Phillips Bond, born 1825, Harvard College 1844, director of the Harvard College Observatory 1859-65) and his contemporaries, on the other hand, were firmly grounded in the German methods, then, as now, the most philosophical and thorough.

It was not until 1850, or later, that it was indispensable for an American astronomer to read the German language and to make use of the memoirs of Bessel, Encke and Struve, and the text books of Sawitsch and Brünnow.† This general acquaintance with the German language and methods came nearly a generation later in England. The traditions of Piazzi and Oriani came to America with the Jesuit Fathers of Georgetown College (1844), of whom Secchi and Sestini are the best known.

The dates of the foundation of a few observatories of the United States may be set down here. Those utilized for the observation of the transit of Venus in 1769 were temporary stations merely. The first college observatory was that of Chapel Hill, North Carolina (1831); Williams College followed (1836); Hudson Observatory (Ohio) (1838); the Philadelphia High School (1840); the Dana House Observatory, of Harvard College (1840); West Point (1841); the United States Naval Observatory (1844); the Georgetown College Observatory (1844); the Cincinnati Observatory (1845); the new observatory of Harvard College (1846); the private observatory of Dr. Lewis M. Rutherfurd in New York City (1848); the observatory at Ann Arbor (1854); the Dudley Observatory at Albany (1856); and that of Hamilton College (1856).

These dates and the summary history just given will serve to indicate the situation of astronomy in the United States during the first half of the present century. A little attention to the dates will enable the reader to place an individual or an institution on its proper background. It must constantly be kept in mind that the whole country was very young and that public interest in astronomical matters was neither educated nor very general. The data here set down will have a distinct value as a contribution to the history of astronomy in America. The developments of later years have been so amazing that we forget that the first working observatories were founded so late as 1845.

American science is scarcely more than half a century old. The day will soon come—it is now here—when we shall look back with wonder and gratitude to ask who were the men who laid the wide and deep foundations which already maintain so noble an edifice.

EDWARD S. HOLDEN.

Mt. Hamilton, Cal., April, 1897.

* He was, however, director during the years 1861-65.

† Dr. Bowditch learned to read German in 1818, at the age of 45.

ENGINEERING NOTES.

The fastest and longest run of a train hauled by an oil-fired engine is (says The Engineer) that of the Cromer express, on the Great Eastern Railway. Leaving Liverpool Street terminus at 1:30 P. M., this train arrives at Cromer—138 miles' distance—at 4:25 P. M., with but one stop at North Walsham, eight miles from Cromer, where it is due at 4.10. This gives a run of 130 miles in 160 minutes, or an average rate of 48·75 miles per hour. The train is regularly worked by the single driver express engine of Mr. Holland's standard design, and fired on his oil fuel system, and no similar fast train in the world is worked with such ease to the firemen.

Haulage ropes are generally made of steel wire, in Germany mostly of plow steel. According to a recent article in the Zeitschrift des Vereins Deutscher Ingenieure, ropes of aloe fiber may compete with steel, even for deep shafts. The aloe fiber is stronger and more elastic, but less flexible than manila hemp; its chief advantage is that it becomes stronger in damp places. The ropes have to be tarred, but, in spite of this circumstance, the corresponding lengths of rope which would break by virtue of their own weight are 12,000 for aloe and 12,500 for steel. In Belgian mines haulage by means of aloe ropes is quite common; great lengths are made with decreasing thickness.

General Wilson, chief of engineers of the army, has been making an examination of the report of the Mississippi River Commission and has brought to light some very interesting facts connected with the flood of last spring. It is shown that the flood of the Mississippi was the highest of which there is any record. The total length of the levees on both sides of the river was 1,377 miles, and there were in all thirty eight breaks by the flood, aggregating eight and seven-tenths miles. An interesting feature of the breakages is that none of the levees built by the United States government were broken, but the breaks occurred in those portions which had been built by States or municipalities or private persons. The Mississippi River floods will form an important part of the annual report of General Wilson, which is now in the course of preparation.

River dredging for gold is a new development in the mining industry which has attained a good deal of importance during the last two or three years, and dredges are now working successfully in the United States, in Georgia, Montana, Idaho and California. They have been especially successful in New Zealand. The amount of gold won in this manner in 1897 will be considerable, and next year it is likely to be still greater, the success of the dredges now employed being well established, and there being undoubtedly a good many places where they can be put to work to advantage. The idea is by no means a new one. As long ago as 1885 a company was organized to exploit the bed of the Atrato River, in Colombia, in this manner, but owing to defective apparatus, or perhaps to some extent to mismanagement, the undertaking failed, although there is reason to believe that the bottom of that river is rich in gold.

It sometimes happens in a machine shop that a piece of work is spoiled, or a tool broken, through not being stopped at a definite point in its progress. A simple piece of apparatus has just been devised which is applicable to any machine tool, and which stops the machine when a certain amount of work has been done. It consists of an electrical relay, which, when a current passes through it, releases a weighted lever, which shifts the belt and so stops the machine. At the same time an electric bell commences ringing to call the attendant's attention, the contact pointer is insulated from the machine bed, and the instrument is so placed that when the feed gear has moved the tool over the distance required it makes contact with either the slide rest or other moving part of the machine. A battery of a few Leclanché cells is sufficient to work several machines. This might prove a most useful labor saver, but as its object is to enable one man to look after two or three machines, its introduction is certain to be opposed by the workmen.

Engineering skill is likely to play an important part at Vladivostok, a prominent Russian port and the terminus of the Siberian Railway, but where for over four months the port is blocked up with ice, rendering shipping traffic impossible. For many years the Russian authorities have been endeavoring to overcome these natural difficulties, and some time ago ice breaking ships were introduced to break open the ice, an operation, however, which has proved practically useless. It is now reported that "a certain engineer" has proposed a plan for reclaiming the narrowest part of the Tartar strait between Saghalien and the Russian mainland. The theory of such an undertaking is that, if this is done, the cold current which enters the Japan Sea from the Arctic via Behring Strait will be checked, and the passage of the warmer tide, coming from the south through the Tshuma Strait, will make the water on the coast of Japan as warm as Vladivostok, and the latter will be warm all the year round. The expectation is entertained that this remarkable engineering work will be entered upon after the completion of the Siberian Railway.

In a new system of sinking shafts through quicksands and water-bearing strata by means of a freezing process, invented by Louis Koch, says The Engineering and Mining Journal, gaseous carbonic acid, ammonia, or a mixture of dioxide of sulphur, is circulated in specially constructed tubes, whereby a degree of cold of from 40° to 60° C. is generated and communicated to the ground. The freezing pipes are sunk through the bedrock, where the shaft is to be constructed, and this can be done in any direction and in any required number. Then they are connected with the condenser and the compressor, and a conduit is constructed for returning the expanded gases to the machine. The compressed gases become volatile on leaving the compressor in the connecting pipe, and take their course, directly or indirectly, as vaporous gas through apertures into the freezing apparatus, in order to enter into two separated conduits and thence into the various divisions of the apparatus and there to generate cold. The generation of cold thus takes place simultaneously and uniformly throughout the whole length of the combined apparatus.

ELECTRICAL NOTES.

The trains on the Bavarian railroads carry telephone receivers and transmitters, by which trainmen can at any time communicate with the nearest station.—Electrotechnische Rundschau.

In 1837, when it was proposed to erect a telegraph between St. Petersburg and Peterhoff, Schilling suggested as an alternative to a cable that the wires should be carried on posts, but one of the members of the commission said that "Wires in the air are truly ridiculous." Sixty years afterward the British authorities think so too.

The Italian Mediterranean Railway Company have, it is said, made a contract with the Electrical Company of North Italy to apply their electric brakes to both the passenger and goods trains between the stations of Bardonnechе and Modane on the Mont Cenis line. Should the trial be satisfactory, the whole of the line between Modane and Turin will be similarly equipped.

Workmen are now engaged in completing the installation of the electric light at the Houses of Parliament. Electricity reigns supreme in the dining rooms, lobbies, and corridors, and its use is gradually extending to the committee rooms. On the Peers' side, the Royal Gallery is being treated in a similar manner, and the dining room and grand committee room will be attended to in due time. Throughout the entire building there are no fewer than 5,000 lights.

The total length of the world's telegraph system has now reached 4,908,921 miles, exclusive of 180,440 miles of submarine cables. Of this Europe has 1,764,730 miles; Asia, 310,085 miles; Africa, 99,419 miles; Australia, 217,470 miles; and America, 2,510,548 miles. United States Consul Germain, who sends these figures to the State Department from Zurich, says they show that, notwithstanding the steady increase in the building of telegraph lines all over Europe, America leads the world and has almost double the European mileage.

A New York contemporary gives a description of a hoist magnet worked in connection with an electric traveling crane. The double-pole magnets in use at the plate mill of the Illinois Steel Company can handle with safety five tons, and only take about four ampères with a 250 volt current. After the magnet has been lowered on to a pile of plates, and several plates have been taken out together, the operator breaks the current for a moment, and one or two plates drop off at each break. It is said that enough residual magnetism remains in the plates next to the magnet to hold them until the current is again switched on. A concentric pole magnet has been constructed for handling hot plates and ingots, and there has been no difficulty in handling a 6,000 lb. or 8,000 lb. ingot at a low red heat.

The cable that is being laid between London and Birmingham for telegraphic purposes is making slow progress, and possibly the end of the century will arrive before it is in full use. It is not, it appears, to act as a substitute for the overhead wires, but is merely to augment the service and provide a means of avoiding the effects of storms. The new cable is being laid at a depth of about 2½ ft., and is described as of a kind which has not been used hitherto for telegraphic purposes, though it has been adopted to a great extent for telephonic services. Inclosed in a metal tube about 2 in. in diameter are 76 copper wires, and the novelty in the construction is that the wires are insulated from each other and from the sheathing by paper. Air passes between the wires and their wrappings, and assists in their insulation. It is thought that if the cable can be kept free from water, there is no likelihood that the paper will perish, and means to secure this freedom from damp are being taken while the cable is being laid.

A new railway signal is being tried on the Delaware, Lackawanna & Western Railroad, at Kingsland, N. J., U. S. A. The signal is peculiar, says The Electrician, in that the semaphore is pivoted at the center and revolves as an indication of safety. When it remains immovable it indicates danger. The semaphore arm is supported on a bracket fixed to the semaphore post and is operated by an electric motor. Placed on a spindle above the box containing the motor is a red signal lamp, which is obscured twice by each revolution of the blade, and the resultant flashes serve as a night safety signal. The continuous red light corresponds with the stationary arm day signal, and indicates danger at night. When the blade assumes the danger position it stands out horizontally, as do the ordinary semaphore signals. Two cells of storage battery are used for the operation of the motor and the track circuits. The cells are placed within a proper receptacle at the base of the semaphore post, and in the present instance have proved very satisfactory in operation. They are charged by a dynamo located in the railroad shops near by.

Most of the machinery in the Swedish iron ore mines is worked by electric power, and the installation at Grangesberg is the first long distance transmission of electric power in Sweden, says the Iron and Coal Trade Review, the distance from the Hellsjon Lake to Grangesberg being some 7½ miles. At Hellsjon, where the turbines are placed, there are three dynamos, one of 150 horse power and two of 100 horse power each, direct coupled to a turbine making 600 revolutions. The three phase current, of 150 volts pressure, is subsequently transformed into one of 3,500 volts. In addition to the above three generators there are two more 100 horse power dynamos, each in connection with a turbine; the one supplies a single phase current for lighting purposes, while the other can give either a three or a single phase current and is held in reserve. There are altogether twelve motors, varying in capacity from 45 horse power downward. Dynamite is used for blasting purposes, and is manufactured on the spot; the annual production is about 80 tons, of which half is used in the Grangesberg mines. The largest mine is the "Skarnlugen." Hitherto the ore has been put direct on to the trucks, but it is now broken at a lower level than that of the railway. The ore is separated from the rock in the mine; an electric ore separator is being installed. The bore holes are now larger (22 millimeters) and deeper than used to be the case, whereby less dynamite is required. The work is carried on night and day, electric light being installed.

MISCELLANEOUS NOTES.

A splendid deposit of copper has been discovered on the west coast of Newfoundland, says the Times. Analysis shows that the ore contains 83 per cent. of copper. It is located on the treaty shore, but can be worked through the new railway.

M. Michelin proposes to insert a clause in the next French budget for the withdrawal of copper coins of ten and five centimes from circulation and replacing them with nickel coins of twenty, ten, and five centimes. If the proposal is adopted, a total of 70,000,000 francs will be struck off. To avoid confusion with the silver currency the nickel coins will be pierced in the center and will have a smooth edge. They will be composed of 25 per cent. nickel and 75 per cent. copper.

The growth of the naphtha industry in Russia has been a rapid one. In 1870 the output of naphtha for the whole of Russia did not exceed 1,730,000 poods; in 1882 the yield was already more than 50,000,000 poods; ten years later, about 300,000,000 poods; and in 1894, 316,000,000 poods, of which 300,000,000 were obtained in the Baku government. Not all this immense quantity of naphtha is consumed by Russia alone, which has increased the export of naphtha and its products from 1,000,000 poods in 1881 to 60,000,000 in 1893.

More than 500,000 sewing machines are made in this country annually, which is 90 per cent. of the production of the world. Nearly 100,000 persons in one way and another make their living in this country out of sewing machines. In no branch of manufactures has a greater revolution been wrought by the sewing machine than in boots and shoes. In 1861 the first machine for sewing on soles was put into operation and a royalty of two cents on shoes exacted. By the aid of machines 350,000,000 pairs of shoes had been made up to 1877 in the United States, and probably an equal or greater amount in Europe.

A new use for peanuts is developing as the peanut butter industry becomes better understood. This product of the peanut answers in the place of ordinary butter for table use and is said to be excellent for shortening purposes, and for gravies, sauces, etc. In point of purity it is superior to the best dairy butter. It is well designed for the use of vegetarians who strenuously object to anything animal. There is already a considerable demand for this butter substitute, and it is very probable there will be an enlarged market for the nuts. At present the product of the United States is about 500,000 bags annually and that of the world is 600,000,000 pounds.—West Coast Trade.

Aluminum has replaced wood in parts of machinery, and it is also being used in place of rubber. The Waldo Foundry, of Bridgeport, Conn., has recently cast several thousand aluminum mouthpieces for graphophones. These were formerly made of rubber, but it is found that aluminum gives far better results, as it is more resonant. A very useful article made by the Waldo Foundry is chemical crucible tongs of aluminum. These are light and handy, and are not eaten by acids. Chemical tongs of other metals turn black, but a pair of aluminum tongs, used in the foundry laboratory for several years, are as bright as when first made.

Yankee ingenuity has produced a soapstone boot drier which should prove extremely useful in winter time. It consists of a block of soapstone, 8 by 2¼ by 1½ inches in size, attached to a wire bail for convenience in handling. There are grooves on the bottom running at right angles with each other, and holes which pass entirely through the block vertically to facilitate the escape of moisture. This commodity is designed largely for use in connection with rubber boots and shoes, leather boots, etc., and is especially recommended by the manufacturers for campers, lumbermen and others, who, by heating the stone and placing it in position after the footwear is removed, exhaust the moisture without injury to the fabric.—Philadelphia Record.

The Explosives Department of the Home Office has recently had under consideration the question of the restrictions to be applied to the manufacture and keeping of acetylene gas, and has conducted various experiments with the object of gaining information on this matter. The results show conclusively, Engineering reports, that acetylene gas when under a pressure of something less than two atmospheres is violently explosive; whereas at a pressure of less than 1½ atmospheres it appears to be reasonably free from liability to explosion, provided it is not admixed with oxygen or atmospheric air. For commercial and practical purposes it is considered sufficient to allow a pressure of 20 in. of water above that of the atmosphere (roughly about 1½ atmospheres), and it is accordingly proposed to draw the safety line at this point, and to declare acetylene when subject to a higher pressure to be an "explosive" within the meaning of the Explosives Act, 1875. In France and Germany, the authorities have fixed the limit of danger at 1½ and 1·1 atmospheres respectively, and have imposed prohibitions or restrictions on the keeping or manufacture of the gas when it is at a higher pressure.

Not so many improvements have characterized the process of coating cloth with rubber as have marked the progress of some other features in the application of that material in the arts. The chief solvents used in dissolving the rubber for coating purposes are naphtha, shale spirit, and benzol, these being mixed with purified solid paraffin by grinding together. Solubility is promoted by grinding or working; the raw or washed rubber is less soluble than that masticated or ground, and well ground rubber is more easily taken up than that which has been less worked. The washed rubber is for waterproofing, says the Boston Commercial Bulletin. The next operation is to grind the rubber and pigments together, run it out into a thin sheet and digest in naphtha, with a slight stirring as it is added, and the finishing is performed by dough mixers. The treatment of fabric which has to be done by spreading with the rubber consists in passing it through a pair of calenders, in order to press down knots and give a smooth and even surface, after which it is passed over a steam chest to expel moisture, it being now ready to receive the first coat. A little oxide of zinc or a little naphtha, which is retained by the rubber and which it gives up very slowly, is a drying which proves quite useful and prevents blistering in curing.

THE TRANS-SIBERIAN RAILWAY.

BEGUN in the month of May, 1891, the work of constructing the great Trans-Siberian Railway has been pursued with what may be called feverish haste. Such haste, although excessive, is nevertheless preferable to too great dilatoriness. After deciding to undertake the work, the Russian government immediately got at it, and it is certain that the Asiatic transcontinental will be completed within the time originally fixed. On the day upon which the last rail has been bolted, the new railway, although inadequate for an extensive traffic, and not as yet possessing all of its commercial utility, will nevertheless possess all of its political importance. The two extremities of the Czar's immense empire will be closely connected, a route to China will have been created, and Russia, mistress of such route, will improve it at her leisure.

At the end of last year the trains starting from TchelIabinsk were already running as far as to Krasnoiarsk. This city, of rich and flourishing aspect, is destined for considerable development. An English company, which has recently established entrepots here, is bringing in by ocean and river large quantities of products of English manufacture, principally linen and cotton goods.

At the end of January the section from Krasnoiarsk to Kainsk was open to the running of trains. From Kainsk to Kloutchi, too, the road is finished, but trains are running thereon only irregularly.

The section of the line that is to run around Lake Baikal from Irkoutsk to Mysovsk is for the moment entirely neglected. The government has decided to postpone the construction of the railway in this rough and mountainous region, the cost of which, it is calculated, would be $80,000 per mile. The project is to employ large ferry boats of the American type, powerful enough to break the ice in winter, for carrying the trains from one shore of Lake Baikal to the other. These boats, gaging 4,000 tons, will be provided with two screws driven by a 3,750 horse power steam engine. They will be capable of carrying a train of twenty-five cars at a speed of about fifteen miles an hour, and will consequently take three hours to cross the lake.

In order to reach Lake Baikal from Irkoutsk, one ascends the river Angara. In winter this river is frozen over at Irkoutsk, as is also the lake for its entire extent. Nevertheless, starting from the Baikal, for a length of from six to nine miles, the river never freezes. This curious fact must be attributed both to the swiftness of the current at this place and to the relatively high temperature of the deep water of the lake, which is fed by a large number of warm springs.

The work on the railway is being resumed at Verkhne Oudinsk through Transbaikalia. As far as to Tchita it is not far advanced, but from Tchita to Nertchinsk it is being pushed with the greatest activity. This important section will be opened to exploitation during the course of next year.

The line of Manchooria, designed to replace the north-south. This section, which is called the Oussouri Railway, has just been completed, but it is not probable that the exploitation of the line can be begun for several months yet.

In leaving Khabarovka, the direction line follows for 270 miles the right bank of the Oussouri, the left bank of which belongs to Chinese Manchooria. The valley of the Oussouri is narrow. This river, all along its course, receives numerous torrents and a few affluents of a certain importance, separated from each other by high offshoots of the Sikhota chain of mountains. No part of the Trans-Siberian necessitated so many bridges and cuttings and so much filling in. It has been possible, however, to avoid the construction of tunnels. In this valley, moreover, an enormous amount of rain falls every year. Inundations are frequent, and wherever the railway approaches the bed of the Oussouri important sustaining walls have had to be built in order to protect it.

Three of the bridges over the affluents of the Oussouri are 840 feet in length. These are those of the rivers Khor, Bikin and Ima. Like the rails, the bridge iron came from the Russian works of the Oural and Donetz. As the superstructure of these bridges could not be of a single span, it rests upon two stone piers. The establishment of a masonry pier in the bed of a Siberian river, such as the Ima, which is immeasurably swollen at the time of the melting of the snow or as a consequence of torrential rains, and which is covered for four months with thick ice, required special pro-

CRIMINALS WORKING UPON THE TRANS-SIBERIAN RAILWAY UNDER THE SUPERVISION OF SOLDIERS.

Kloutchi is now the terminus of the Trans-Siberian of the west, and we have just learned by telegraph that Khabarovka has, for some days, been the terminus of the Trans-Siberian of the east, or the Oussouri Railway, the head of the line of which is Vladivostok. From Kloutchi to the Oussouri, that is to say, from the center of Russian Asia to the shore region of the Pacific, nearly a hundred thousand laborers are busily engaged upon the colossal work. Some of these, such as the blacksmiths, carpenters, etc., are free workmen, while others, who are employed upon rough work, such as digging trenches, filling in, carrying wood and iron, etc., are criminals who are closely watched by soldiers. On the west and east sides the rails are being rapidly laid and the sections constructed simultaneously at a large number of points are being connected. Strietensk and Khabarovka, which were connected during the summer by steamboat service upon the river and its affluent, the Chilka, will be the two provisional extremities of the line.

Between Kloutchi and Irkoutsk the work is far enough advanced to allow it to be seen that in January, 1898, travelers starting from Moscow or St. Petersburg will reach Lake Baikal without leaving the cars. Along the postal road from Irkoutsk to Krasnoiarsk travel innumerable caravans, some bringing into Russia bales of tea that have come from China through Kiakhta, and others carrying to Irkoutsk European merchandise from the entire region of the Baikal. Such animation is a good omen for the traffic of the railway.

Strietensk Khabarovka section, will make a connection between the cities of Nertchinsk and Strietensk.

Strietensk, upon the Chilka, and Khabarovka, upon the Amoor, would be connected by an admirable water way if the Siberian winters were not so severe. Unfortunately, the Amoor and its affluent the Chilka are free from ice only from May to September. Navigation, therefore, lasts but four months, or five at the most; but during this very short period it is very active.

Upon the Amoor, at a nearly equal distance from Strietensk and Khabarovka, at the mouth of the river Zeia, which comes from the country of gold mines, there has been built an important and growing city. This is Blagovestchensk, which is both a mining center and a fluviatile port of the first rank. The complete melting of the snow and breaking up of the ice in the river take place here toward the middle of May. It is then that the city is busiest. Numerous boats daily arrive and start and ascend or descend the Amoor. The majority are now occupied in the carriage of rails and other materials designed for the railway. The Transsiberian, until it is finished, will thus absorb the entire activity of Siberia.

One of the boats that descend the river takes us to Khabarovka, at the confluence of the Amoor and Oussouri. Khabarovka, which is a military city, is the residence of the governor general of the three provinces of Transbaikalia, Amoor and Littoral. Thence to Vladivostok, the railway leaves its general direction from west to east, in order to take a direction exactly

cesses. It was necessary to take advantage of the period of congelation of the water. The materials were easily carried upon the ice by means of sleighs. Around the site of the pier foundations, upon the frozen surface, was constructed a wooden house for the workmen, and it was in the interior of this, protected from the cold, snow and storms, that they did their work. When the period for the ice to break arrived, they removed their improvised shop, but the pier remained ready for the reception of the long metallic superstructure.

Upon the river Ima is situated the little village of Iman, where but yesterday stopped the trains coming from Vladivostok, and which thus acquired a certain temporary importance. It was here that was unloaded the merchandise for transshipment upon boats that afterward reached the Amoor in descending the Oussouri. The boats that did the carrying were those that had brought either to Iman or to the different points situated between Khabarovka and Iman the materials taken aboard at Nikolaievsk, a seaport at the mouth of the Amoor and designed for the construction or exploitation of the railway.

From Iman station to that of Vladivostok the line (upon which trains have been running since 1895) is 265 miles in length. The locomotives were, almost all of them, purchased in the United States. As for the cars, they came for the most part from the great Russo-Baltic works of Riga. A few of them were purchased at Vladivostok.

At 37 miles from Iman the line crosses the Oussouri

upon a new bridge. To the west it leaves Lake Khanka, a simple permanent inundation called by the Chinese Khun-Khat, or "Mediterranean." Then the road follows the valley of the river Lefou, which falls into this lake not far from the station of Nikolskoie, which is destined to become the head of the line of

BRIDGE OVER THE OUSSOURI, 288 MILES FROM VLADIVOSTOK.

the Manchooria Railway. After leaving this station, which is 83 miles distant from Vladivostok, the line enters the valley of the river Soulfoun. The inundations of this little affluent of the Sea of Japan are far more dangerous than those of the Oussouri. The line along the side of the mountain had been insufficiently studied, and the exploitation had hardly been begun when the engineers perceived that an entire section, constructed upon loamy earth, at about 50 miles from Vladivostok, was slowly descending into the Soulfoun. Such sliding could only be arrested at the cost of important works that have been but recently finished. Could this valley, so beset with obstacles, be avoided? Competent men think that it could, and adversely criticise the direction line that was adopted between

BRIDGE OF THE RIVER LEFOU, AT 100 MILES FROM VLADIVOSTOK.

Vladivostok and Nikolskoie, in that it causes the railway to run a greater danger than that of the inundations from above and slidings from below, since twelve miles before reaching Vladivostok the line runs along the shore of the bay of Peter the Great, and in case of war it would be easy for the ships of an enemy to bombard the track, and thus cut off the communication of Vladivostok with the valleys of the Oussouri and the Amoor. Such considerations, it is said are capable of determining the abandonment of the present line and the selection of a new one nearer to the east.

The general rules laid down for the entire Transsiberian have naturally been applied to this eastern section. The track is single and the most distant stations are 23 miles apart. Three trains a day are run in each direction.

"Vladivostok! all out!" It would not be commonplace to hear this cry on the evening of the tenth day passed in a car of this monster Oriental Express that the Trans-Siberian train will be. But it is only in France that travelers are thus notified as to what they have to do by the indistinct yells of men appointed for the purpose.

Vladivostok, the name of which signifies "Ruler of the East," and which has been developing for the last two or three years with a rapidity seen only in American towns, was founded in 1861 at the extremity of a peninsula that divides the bay of Peter the Great into two parts. This peninsula is continued by a group of islands, the principal of which is Kozakovitch. The strait that separates this island from terra firma has received the name of the Eastern Bosphorus. It is in the center of this strait that has been built the city of Vladivostok surrounded with verdant hills, which themselves surround one of the finest natural ports in the world, called by the Russians the Golden Horn.

Vladivostok is not yet, but may hope to become the Constantinople of the Far East. Its climate, without resembling that of Marseilles, which is in the same parallel, is not so severe as might be supposed. Like the port of Odessa, the Golden Horn is blocked by ice for only a month and a half or two months in the year.

Two Russian ports upon the Pacific now divide between them the importations of European merchandise—those of Vladivostok and Nikolaievsk. The latter, although closed for six months of the year, has for a long time been able to benefit by its situation at the mouth of the river Amoor, which carries the imported products into the interior. Nevertheless, in recent years, the supremacy of Vladivostok has become indisputable, and the completion of the Transsiberian and opening of the Transmanchoorian will definitely consecrate it.

The vessels that the Golden Horn receives bring to Siberia linen and cotton goods from England, the same goods, but in ordinary quantities, along with tobacco, sugar and alcohol, from Russia, glass and table utensils from Belgium, flour, machines and farming implements from the United States, agricultural products from Corea, fruit and rice from Japan, etc. The exportations from Vladivostok, which up to the present are not of much importance, consist of furs and especially various products derived from the whale and seal fishing.

The commerce of the city is concentrated in the hands of foreigners in the proportion of 75 per cent. Of the business about 30 per cent. is done by Germans, about 13 per cent. by English and Germans, 12 per cent. by Chinese and 5 per cent. by Americans.—L'Illustration.

THE DETERRENT INFLUENCE OF MODERN ARMS.*

By Gen. O. O. HOWARD, U. S. Army (retired).

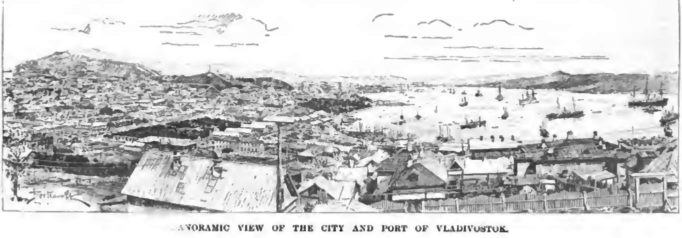
IT is now a common thought, regardless of the spurs of religion, which probably are as active to-day as ever in history, and one independent of the blessings attendant upon peace makers and peace seekers everywhere, that the modern improvements in arms, arrangement and methods of war will have, nay, have already had, a strong deterrent effect against war upon all the civilized peoples and governments of the world.

It is said by one of our scientific thinkers that all anger thought and fear thought come from mental germs of abnormal growth, and that they can be and should be torn up by the roots and cast away. I am of the mind, judging from passing events, that the day has not yet come for this; and that fear and anger will remain for some time to be quite generally predicable of human souls and of nations. Certainly while fear continues, battle and war will excite it, as they always have done; and more and more will be the apprehension as the probability of perishing in a conflict increases. The soldier cannot help seeing and knowing the facts of extreme danger; and even if he be brave enough to take desperate chances or march to certain death, still his government or the people back of it will be unwilling to make the sure sacrifice of his life.

The rifle now used in our regular army, named the United States magazine rifle, was adopted in 1892. The weight of the weapon is nine pounds, having a caliber of 0·31 of an inch. Its sight is graduated for a range of 1,900 yards, but it can be fired easily 3,000 yards. Its bullet has a weight of 220 grains. Its flight is swift and almost noiseless. The smokeless powder renders the place from which it starts impossible of discovery by observing enemies. When it strikes the hardest wood its effect is several times greater than that of any rifle which we used in the late war. Think of those experiments with this rifle at our proving grounds, where block after block of pine lumber, each an inch in thickness, was added till there was an obstruction of four feet. Those little steel-headed projectiles, sent from a gun a thousand yards away, easily passed through the blocks without injury to themselves. Three feet of oak fared no better, while even iron plate three-quarters of an inch in thickness suffered a like perforation. I remember the grim effect upon my young heart more than forty years ago when I first saw a riddled target, and was asked by a companion how I would like to stand that racket. This modern firing is considerably worse and done at once. By observation it is found that men's arteries are severed as if cut by the lancet and the bones are comminuted as if dried and pounded in a mortar, and yet the bullets themselves receive little or no injury. Ours is a magazine gun and supplies five cartridges at a time. This is the rifle with which a soldier may easily hold his aim and send twenty bullets against the target or an adversary each minute. Should he desire to fire without aiming, the number of shots may be doubled. His only limit in destructiveness will be found in the size of the ammunition load which he can carry.

Should an enemy in close formation come near a company, say of not to exceed twenty men, the members of that company could easily dispose of, by death and wounds, from eight to ten thousand men in less than an hour's time. It is not likely that just this arrangement could ever be made for twenty marksmen, but I offer this object lesson to indicate the effects of this modern

* From The Independent.



ANORAMIC VIEW OF THE CITY AND PORT OF VLADIVOSTOK.

arm. With an intrenched regiment having this United States magazine rifle, a regiment of a thousand men like the Third Maine, the Second Massachusetts, the Second Vermont or the Ninth Indiana of our war, whose prowess in action I so often observed or knew of, a skillful colonel would be able to hold his ground against any successive rushes which ten thousand men could make. With plenty of ammunition, a star fort, having its approaches properly earth covered and its parapet guarded by such rifles, could not be taken by assault. Had Lee's troops been thus armed at Fredericksburg, every man of ours who passed beyond the line of the city houses and approached the Marye Heights would have fallen, and Burnside could not with his army have recrossed the Rappahannock.

I notice that the Hotchkiss rifle, a field cannon, has been much experimented with at our proving grounds, and is in our service in both army and navy. Its trials varied from 100 to 4,000 yards. The weight of the powder in a charge is about two pounds, and the length of the cartridge complete is 19 inches; the shell is steel. In firing for rapidity and with accuracy at 4,000 yards, ten shots were fired with but one miss. The ten rounds were fired in 2 minutes and 26¾ seconds. At one mile range were fired ten shots, again with but one miss, all in 1 minute and 33½ seconds. This gun easily sends its projectile a distance of five miles.

What is called the six pounder Maxim-Nordenfelt gun, or some slight modification of it, is the one about which so many inquiries are made in the journals of the day. We have had this gun under trial since 1894, firing it with rapidity and accuracy through different ranges. The provers began with one sighting shot, then delivered ten shots without a miss. The deviations from the middle of the target were inconsiderable. This was accomplished in 2 minutes and 37¼ seconds for a one mile range. For a three mile range three trials were allowed for the sighting, then ten shots quickly followed at the target and all hit. The caliber of this cannon is 2·244 inches. The estimated time is 20 rounds per minute, or 65 rounds in three minutes. The Germans called the field pieces to which I refer, after making their own improvements upon them, "the model of '73 and '78," the caliber being 88 millimeters (3·3 inches). During 1890, the Germans succeeded still further with these field guns and their carriages, making progress. Their new gun is now denominated the model of '91. They have secured elasticity of metal and increased tenacity, thus eliminating, as far as possible, dangers from breakage and bursting, which, of course, always had immediate deadly effects upon their own artillerymen, and could not help causing widespread apprehension and terror among them. And again, in their carriages and ammunition wagons made for these guns they have secured greater lightness, and are now in these respects considerably ahead of the French.

The smokeless powder will aid much both the French and the Germans in gaining for themselves a prospective morale over a foe not so well furnished—a foe having only other kinds of powder. It is interesting to observe the efforts made by German officers to have exploding shells give some plain signs of where they strike. I am reminded of our own efforts in the war to read the enemy's signal code. The German artillerists, using the smokeless powder in their cannon, "put 300 balls into the shell, and in the interstices of these balls they introduce a powder whose composition is a secret;" that is to say, thus far secret. The French can analyze, and so can our chemical experts. That new explosive mixture is colored. The impact and explosion of these shells can, now, from the flash, be easily detected by a field glass at a distance of three miles. We shall soon be abreast of other armies in such things as these colored flashes, enabling the battery officers to measure length of range and discover far-off points of danger and obstacles to be overcome. No one can exaggerate the effect of a battery thus equipped, after the range shall be ascertained—its effect against infantry, cavalry or inferior artillery. Troops in open ground without cover, so withstood, must give way or be practically annihilated.

THE WORSHIP OF METEORITES.*

HERE is a small fragment of iron that has a curious history. It is a portion of a mass of meteoric iron found upon a brick altar in one of the Ohio mounds. Along with it were various objects—a serpent cut out of mica—several terra cotta figurines—two remarkable dishes carved from stone into the form of animals; pearls, shells, copper ornaments and nearly three hundred ankle bones of deer and elk. There were but one or two fragments of other bones, and one animal furnished but two of these ankle bones; hence they must have been selected for some special, important reason. The figurines had been apparently broken for some purpose, and the whole collection had suffered in the fire not a little. In a like altar of another mound of the same group were found nearly two bushels of like objects.

It must have been in some ceremony of a religious, possibly one of a funereal, character that the mound builders collected hereon the altar their ornaments and other valuables, and after burning them buried the charred débris in the huge earthen mound that was built over them and the altar.

What would we not give if this fragment could be endowed with the power of repeating to us its experience—chapters in the history of that people? But nearly all that we can say is that it was found among objects held by them in peculiar esteem, and used by them in some serious, probably religious ceremony.

There was formerly, and so far as I know there is still, in the collection of meteorites in Munich, a stone that weighs about a pound. It fell in 1853 in the region north of Zanzibar, on the East African coast, and was seen and picked up by some shepherd boys. The German missionaries tried to buy it, but the neighboring Wanikas, because it fell from heaven, took it to be a god. They secured possession of it, anointed it with oil, clothed it with apparel, ornamented it with pearls, and built for it a kind of temple to give it proper divine honors. The agents of the missionaries were not allowed even to see the stone, far less could they purchase the Wanika's tutelar deity. Neither entreaties, nor arguments, nor offers of the missionaries, nor of the officials were of any avail. But when three years later the wild nomad tribes of the Masai came down upon the Wanikas, burned their village, and killed large numbers of them, the Wanikas thought very differently of the stone's protecting power. In fact, they lost all respect for it. A famine having meanwhile arisen, the elders of the tribe were quite ready to exchange their palladium for the silver dollars of the missionaries.

Among the Buddha legends is one of two merchants who offered food to the Buddha, which was accepted, and in consequence of their request for some memorial of him the Buddha gave them a hair and fragments of his nails, and told them that hereafter a stone should fall from heaven near the place where they lived, and that they should erect a pagoda and worship these relics as though they were Buddha himself.

The nations of India have always been specially superstitious about stones fallen from the skies. In 1620 an aerolite fell near Jullunder, and the king sent for a man well known for the excellent sword blades that he made, and ordered him to work the lump into a sword, a dagger and a knife. The mass, however, would not stand the hammer, but crumbled in pieces. By mixture with iron of the earth the required weapons were made.

In 1867 a shower of stones fell, some forty in number, at Saonlod. The terrified inhabitants of the village, seeing in them the instruments of vengeance of an offended deity, set about gathering all they could find, and having pounded them into pieces, they scattered them to the winds.

In 1870 a meteorite fell at Nidigullam, and the Hindoos at once carried it to their temple and worshiped it. The same has been repeated in India on the occasion of several stonefalls in the present century. One native ruler refused to allow a stone to be carried across his territory for fear of the injury that might come to his people or his lands.

Two Japanese meteorites, formerly the property of a daimio family, were long kept and handed down as heirlooms, being in the care of the priests in one of the family temples. They were among the family offerings made to Skokujo on her festival days. They were connected with her worship by the belief that they had fallen from the shores of the Silver River, Heavenly River, or Milky Way, after they had been used by her as weights with which to steady her loom. One of these stones was presented by its late owner to the British Museum, and it is in its collection of meteorites.

There is a curious institution among the Chinese that has existed, according to Biot, from a time more than one thousand years before Christ. The Chinese attributed to different groups of stars a direct influence upon different parts of the empire. Some of these groups correspond, for example, to the imperial palaces, to the rivers, the roads and the mountains of China. By reason of this belief, regular observations are made by the imperial astronomers of all that passes in the heavens, especially of the groups of stars in which comets and meteors originate, or across which they travel. The interpretation of what is seen in the sky forms part of the duties of these very important officials. These observations have been carefully written out, and are preserved in the archives of the empire. Upon the ending of a dynasty, by change of name or otherwise, these comet and meteor records have been published as a special chapter of the chronicles of the dynasty. The existing dynasty began in 1647, since which date the records are, therefore, unpublished.

In 1492 a stone of 300 pounds weight fell at Ensisheim, in Alsace. The Emperor Maximilian, then at Basel, had the stone brought to the neighboring castle, and a council of state was held to consider what message from heaven the stonefall brought to them. As a result, the stone was hung up in the church with an appropriate legend, and with strictest command that it should ever remain there intact. It was held to be an omen of import in the contest then in progress with France and in the contest impending with the Turks. Nineteen years later a shower of stones fell near Crema, east of Milan. The Pope was at war with the French, and the stones fell into the French territory. Before the year had passed the French, after a long possession of Lombardy and serious threatening of the States of the Church, were forced to retire from Italy. At this time Raphael was painting for an altar piece his magnificent Madonna di Foligno, now in the Vatican. Beneath the rainbow in the picture, indicating divine reconciliation, Raphael painted also this Crema fireball, apparently to set forth divine aid and deliverance.

I have thus rapidly gone over some selected facts, showing how the mound builders, the wild Africans, the Hindoos, the Japanese, the Chinese, the modern Europeans, have been ready to revere these mysterious bodies that come from the skies. But it is in the Greek and Latin literature that we have reason to expect the more numerous and full accounts, both legendary and historic, of this reverence and worship.

It is now, I believe, admitted by the best scholars that both in Greece and in Italy there was a period, earlier than the age of images, when the objects worshiped were not wrought by hand. Men worshiped trees and caves, groves and mountains, and also unwrought stones. Even after men began to make their objects of worship, these were in many cases mere hewn stones, not images. The earlier Greek term *ἄγαλμα*, an object of worship, stands apart from the latter term *εἰκών*, image.

What would be more natural in that age to the affrighted witnesses of the most magnificent of spectacles, the fall of a meteorite, than for them to regard the object which had come out of a clear sky, with terrific noise and fire and smoke, as something sent to them by the gods to be revered and worshiped? It was nobler to worship a stone fallen from the sky than one of earthly origin.

The worship of an unwrought stone once established has wonderful vitality. For example, the Greek writers speak of such a worship in their day among the Arabian tribes. When Mohammed, with his intense iconoclasm, came down upon Mecca and took the sacred city, he, either for reasons of policy or from feeling, spared the ancient worship of this black stone. Entering into the sacred inclosure, he approached and saluted it with his staff (where it was built into the corner of the Kaaba), made the sevenfold circuit of the temple court, returned and kissed the stone, and then entered the building and destroyed the 360 idols within it. To-day that stone is the most sacred jewel of Islam. Toward it each devout Moslem is bidden to look five times a day as he prays. It is called the Right Hand of God on Earth. It is reputed to have been a stone of paradise, to have dropped from heaven together with Adam. Or, again, it was given by Gabriel to Abraham to attest his divinity. Or, again, when Abraham was reconstructing the Kaaba, that had been destroyed by the deluge, he sent his son Ishmael for a stone to put in its corner, and Gabriel met Ishmael and gave him this stone. It was originally transparent hyacinth, but became black by reason of being kissed by a sinner. In the day of judgment it will witness in favor of all those who have touched it with sincere hearts, and will be endowed with sight and speech. The color of this stone, according to Burckhardt, is deep reddish brown, approaching to black; it is like basalt, and is supposed by some to be a meteorite.

It is not important for my purpose to separate the history from the myth. Eusebius quotes from an old Phœnician writer, Sanchoniathon, that the goddess Astarte found a stone that fell from the air, that she took it to Tyre, and that they worshiped it there in the sacred shrine. We have reason to question whether that Phœnician writer ever lived. What matters it? The existence of the story in Eusebius' time has to us a significance not greatly unlike that of the existence of the worship itself in the earlier years.

Virgil describes a detonating meteor in such terms that I feel reasonably sure that either he had seen and heard, or else he had had direct conversations with others who had seen and heard a splendid example of these meteors. The passage is in the second book of the Æneid. The city of Troy was captured and was burning. All was in confusion. The family of Æneas was gathered ready for flight, but Anchises would not go. An omen, lambent flames on the head of his grandson, began only to shake his purpose to perish with his country. He prayed for more positive guidance. It is Æneas who describes the scene:

"Hardly had the old man spoken when across the darkness a star ran down from the sky carrying a brilliant light torch. We saw it go sweeping along above the roof of the house. It lighted up the streets, and disappeared in the woods on Mount Ida. A long train, a line of light, remained across the sky, and all around the place was a sulphurous smell. A heavy sound of thunder came from the left. Overcome now, my father raised his hands to heaven, addressed the gods and worshiped the sacred star. 'Now, now,' he cried, 'no longer delay.'"

This story is, of course, all legendary, but Virgil's description of the scene is true to life as conceived by pagan Rome in his day.

The images that fell down from Jupiter, or that fell from the skies, are often spoken of by Greek and by Latin writers. I mention three or four cases only where this allusion points to a meteoric origin as possible or probable. The earliest representative of Venus at old Paphos, on the island of Cyprus, was one of these heaven-descended images. It was not the Venus of the Capitol, nor the Venus of Milo, but as described was a rude triangular stone.

Cicero, in the grand closing passage of his oration against Verres, calls upon Ceres, whose statue he says was not made by hands, but was believed to have fallen from the skies. The earliest of the images of Pallas at Athens was said to have had a like origin. Pausanias saw at Delphi a stone of moderate size which they anointed every day, and covered during every festival with new shorn wool. They are of opinion, he adds, respecting this stone, that it was the one given by Cybele to Saturn to swallow as a substitute for the infant Jupiter, which Saturn after swallowing vomited out on the earth.

There is a marvelous story of a peculiar stone in the poem Lithika by the apocryphal Orpheus. Phœbus Apollo gave the stone to the Trojan Helenus, and Helenus used it in soothsaying. It was called Orites, and by some Siderites. It had the faculty of speech, and when Helenus wished to consult it he performed special ablutions and fasts for twenty-one days, then made various sacrifices, bathed the stone in a living fountain, dressed it and carried it in his bosom. The stone now became alive, and to make it speak he would take it in his arms and dandle it, when the stone would begin to cry like a child for the breast. Helenus would now question the stone, and receive its answers. By means of these he was able to foretell the ruin of the Trojan state. Whoever framed that story had, I believe, before him a real stone, and the description is very like that of a meteorite, saying nothing of its having come from Apollo. The Orphic writer says that it was rough, rounded, heavy, black and close grained. Fibers like wrinkles were drawn in circular forms over the whole surface above and below.

Here I show you a stone such as was described—rounded, black, heavy, close grained and having fibers like wrinkles in circular forms over the whole surface above and below.

The name Siderites was at a later date applied to the loadstone, but by this writer the two stones are separately described, and are apparently distinct. If this name was of Greek origin, it seems to be allied to sideros, iron, and this heavy stone, like nearly all meteorites, probably contained iron. If, however, this name came from a Latin source (for it is used both by Greek and by Latin writers), it has affinities with Sidus, a star, and its meteoric character is still more clearly indicated.

One of the most interesting of the stories about images that have fallen from heaven is the basis of that beautiful tragedy of Euripides, "Iphigeneia in Tauris." To many of you the story is familiar, but it will bear repetition.

The goddess Diana detained at Aulis the Grecian fleets by contrary winds, and required the sacrifice of Iphigeneia, the daughter of Agamemnon, before the Greeks could set sail. The father consented; and the daughter, apparently sacrificed, was really rescued by Diana, and borne to the Tauric, or Crimean peninsula on the north shore of the Black Sea. She was then made a priestess in the temple of the goddess. At this shrine the barbaric inhabitants used to sacrifice before an image of Diana, that fell from heaven, all strangers that were shipwrecked upon the coast. The unhappy

* A lecture delivered in New Haven, Conn., by the late Prof. Hubert A. Newton. (Reprinted from the American Journal of Science.)

Iphigeneia, forced to take a leading part in these human sacrifices, laments her sad lot:

"But now a stranger on this strand,
'Gainst which the wild waves beat,
I hold my dreary, joyless seat,
Far distant from my native land;
Nor nuptial bed is mine, nor child, nor friend.
At Argos now no more I raise
The festal song to Juno's praise;
Nor o'er the loom sweet sounding bend,
As the creative shuttle flies,
Give forms of Titans fierce to rise,
And dreadful with her purple spear
Image Athenian Pallas there.
But on this barbarous shore
Th' unhappy stranger's fate I moan,
The ruthless altar stained with gore,
His deep and dying groan;
And for each tear that weeps his woes,
From me a tear of pity flows."

Orestes, the brother of Iphigeneia, had avenged upon his mother the murder of his father. For this he was driven by the Furies. While stretched before the shrine of Phœbus he heard the divine voice from the golden tripod, commanding him to speed his way to the wild coast of the Taurians, thence to take by fraud or by fortune the statue of Diana that fell from heaven, and carry it to Attica. Doing this, he should have rest from the Furies.

He was captured, however, along with his friend Pylades, and brought to the altar to be sacrificed. The relationship of the brother and sister became here revealed, and they together fled, carrying with them the image. It was not without a struggle that they reached the shore, but finally,

"On his left arm sustained
Orestes bore his sister through the tide,
Mounted the bark's tall side and on the deck
Safe placed her and Diana's holy image
Which fell from heaven."

Neptune favored the Greeks, Minerva forbade pursuit, and the image was borne to Halae (or as some said to Brauron) in Attica.

Cicero spoke of the Trojan Palladium as something that fell from the sky: quod de coelo delapsum. Other classical writers, notably Ovid, speak of it in similar terms. The story in its various forms points toward a stonefall as its basis. One form of it runs thus:

Pallas and her foster sister Athena were wrestling with each other, when Pallas was accidentally killed. In grief Athena made an image of Pallas and set it up on Olympus. When King Ilus was about building his city on the Trojan plain he prayed for a favorable omen. In response to his prayer Jupiter cast this image down at the feet of the suppliant king. In the new city it was set up in a temple specially erected to contain and protect it. So long as Troy could keep safely this image, the city, it was firmly believed, could not be taken by its foes.

According to one story, the Greeks stole the image before capturing the city. As many cities afterward claimed to possess the treasure as claimed to be the birthplace of Homer. According to the Romans, Æneas carried the Palladium to Italy, and the image was regarded as the most sacred treasure of the Roman state. For centuries even in historic times it was so carefully kept by the Vestal Virgins that the Pontifex Maximus was not allowed to see it.

We naturally have doubts about the nature, or even the existence, of an object so kept out of sight. What it was that the Vestals thus guarded, or whether they had anything to represent the image of Pallas, will probably never be known. But it is far otherwise with another famous object of Roman worship. To the east of the Trojan plain on which the Palladium fell rise the mountains of Phrygia and Galatia. In Pessinus, near the border line of these two countries, and in the caves and woods near Pessinus, the goddess Cybele, the mother of the great gods Jupiter, Neptune and Pluto, was specially worshiped. This worship may not have been more degrading than the worship of many other Asiatic divinities. But it was wretched and unmanly almost beyond our possible conception. It furnished to Catullus the theme for the most celebrated of his poems, one of the strongest pictures in all literature. The Grecian athlete entered her service with joyful music and dancing. Too late he looks back from the Asiatic shore, out of his hopeless degradation, on the nobleness of his former Grecian life. The lion of Cybele drives him in craven fear again into the wild woods to spend his days in the menial servitude. The Roman poet exclaims, "O goddess, great goddess Cybele, goddess queen of Dindymus; far from my house be all thy frenzies; others, others, drive thou frantic!"

At some unknown early time a meteoric stone fell near to Pessinus. It was taken to the shrine of Cybele and there set up and worshiped as her image. This image and its worship very early attained a wide celebrity. About two hundred years before Christ, in the time of the second Punic war, the stone was transported to Rome. The detailed history of the transfer is given by several writers in varied terms. It forms one of Livy's charming stories, it is told in poetic terms by Ovid, it is given as a tradition by Herodian. For every detail of the history I do not ask confiding belief, but the principal event is, I suppose, historically true.

In the year 205 before Christ, Hannibal had, since crossing the Alps, been holding his place in Italy for more than a dozen years, threatening the existence of the Roman state. The fortunes of war were now somewhat adverse to the Carthaginian general. A shower of stones alarmed the Romans. The decemvirs consulted the Sibylline books and there found certain verses which imported that whensoever a foreign enemy shall have carried war into the land of Italy, he may be expelled and conquered if the Idæan mother be brought from Pessinus to Rome. These words were reported to the Senate. Encouraging responses came at the same time from the Pythian oracle at Delphi.

The Senate set about considering how the goddess might be transported to Rome. There was then no alliance with the states of Asia. But King Attalus was on friendly terms with the Romans because they had a common enemy in Philip II of Macedon. The Senate, therefore, selected an imposing embassy from the noblest Romans. A convoy of five quinqueremes was ordered for them that they might make an appearance suited to the grandeur of the Roman people. The embassy landed on their way and made inquiry of the oracle at Delphi, and were informed that "they would attain what they were in search of by means of King Attalus, and that when they should have carried the goddess to Rome they were to take care that whoever was the best man in the city should perform the rite of hospitality to her." The king received them kindly, but refused their request; whereupon an earthquake tremor shook the place and the goddess herself spoke from her shrine, "It is my will. Rome is a worthy place for any god; delay not." The king yielded; a thousand axes hewed down the sacred pines and a thousand hands built the vessel. The completed and painted ship received the stone and bore it to the mouth of the Tiber.

It was the spring of the following year before the ship arrived. Meanwhile new prodigies frightened the people. A brilliant meteor had crossed Italy from east to west, a little south of Rome, and a heavy detonation followed. From this, or from some other meteor, another shower of stones had fallen. In expiation, according to the custom of the country in case of stonefalls, religious exercises during nine days were ordered. The Senate, after careful deliberation, selected one of the Scipios, deciding that he, of all the good men in the city, was the best, and they deputed him to receive the stone. The whole city went out to meet the goddess. Matrons and daughters, senators and knights, the vestals and the common people all joined the throng. But a drought had reduced the water of the Tiber so that the vessel grounded upon the bar. All the efforts of the men pulling upon the ropes failed to move it. A noble matron who had been slandered stepped forward into the water. Dipping her hands three times into the waves and raising them three times to heaven, she besought the goddess to vindicate her good name if she had been unjustly slandered. She laid hold of the rope, and the vessel followed her slightest movement amid the plaudits of the multitude.

Scipio, as he had been ordered by the Senate, waded out into the water, received the stone from the priests, carried it to the land and delivered it to the principal matrons of the city, a band of whom were in waiting to receive it. They, relieving each other in succession and handing it from one set to another, carried it to the gates of the city and thence through the streets to the temple of Victory on the Palatine Hill. Censers were placed at the doors of the houses wherever the procession passed, and incense was burned in them, all praying that the goddess would enter the city with good will and a favorable disposition. The people in crowds carried presents to the temple. A religious feast and an eight days' festival with games were established to be celebrated thereafter each year in the early part of April.

Before another year had passed, Hannibal, after having maintained his army in Italy for fifteen years, was forced to withdraw again to Africa. From the liberal offerings of the people, in gratitude for deliverance, a temple was erected to Cybele, long known as the Temple of the Great Mother of the Gods, so that twelve years after its arrival at Rome the stone was taken from the Temple of Victory and set up in its new home. A silver statue of the goddess was constructed, to which the stone was made to serve in place of a head. Here, in public view, for at least five hundred years that stone was a prominent object of Roman worship. Its physical appearance is described by several writers. It was conical in shape, ending in a point, this shape giving occasion to the name Needle of Cybele. It was brown in color and looked like a piece of lava. Arnobius, a Christian writer just before the accession of Constantine, and over five hundred years from the date of its arrival at Rome, says of the stone:

"If historians speak the truth and insert no false accounts into their records, there was brought from Phrygia, sent by King Attalus, nothing else in fact than a kind of stone, not a large one, one that could be carried in a man's hand without strain, in color tawny and black, having prominent, irregular, angular points, a stone which we all see to-day, having a rough irregular place as the sign of a mouth and having no prominence corresponding to the face of an image." Arnobius goes on to ask whether it was possible that this stone drove the strong enemy Hannibal out of Italy—made him who shook the Roman state unlike himself, a craven and a coward.

Just when this stone disappeared from public view I do not know. In directing the recent excavations on the Palatine Hill, Prof. Lanciani was at first in great hopes of finding it; because it had no intrinsic value to the many spoliators of Rome nor to the former excavators of Roman temples. But the place in which he expected to find it was absolutely empty. At a later date, however, he found in a rare volume an account of excavations made on the Palatine Hill in 1730, in which the private chapel of the Empress was found and explored. In this we perhaps have an account, and, it is to be feared, the last account of a sight of the Cybele stone. The writer says: "I am sorry that no fragment of a statue, or bass relief, or inscription has been found in the chapel, because this absence of any positive indication prevents us from ascertaining the name of the divinity to whom the place was principally dedicated. The only object which I discovered in it was a stone nearly three feet high, conical in shape, of a deep brown color, looking very much like a piece of lava and ending in a sharp point. No attention was paid to it, and I know not what became of it." This description is almost identical with that given by Arnobius and others of the stone from Pessinus.

Another stone of meteoric origin was brought to Rome, and there for a brief period was most fantastically worshiped. This was near the beginning of the third century after Christ. It came, like the other stones of which I have spoken, from Asia. In the city of Emesa, on the banks of the Orontes, about midway between Damascus and Antioch, there was in those days a magnificent temple of the sun. A gorgeous worship was maintained before a stone that fell from heaven that served as the image of the sun god. The description of the stone is not very unlike that of the Cybele meteorite. Herodian, who probably saw it, says: "It is a large stone, rounded on the base, and gradually tapering upward to a sharp point; it is shaped like a cone. Its color is black, and there is a sacred tradition that it fell from heaven. They show certain small prominences and depressions in the stone, and those who see them persuade their eyes that they are seeing an image of the sun not made by hands."

This sun god was named Heliogabalus, and before the altar a boy of nine years of age began to serve as priest. Such a Syrian service did not make the boy grow manly nor virtuous, and when at the age of fifteen he became emperor through the money and intrigues of his grandmother, and the murder of the Emperor Macrinus, we have for three years at Rome the view of the sorriest scapegrace that ever sat on a throne. He assumed with the name of Antoninus also the name of his god Heliogabalus. To the great disgust of the Roman Senate and people, he brought with him from Syria the image of his god, the sacred stone, and himself continued before it his priestly service with all its fantastic forms and gesticulations. He built within the city walls a grand and beautiful temple, with a great number of altars around it; he repaired thither every morning, and sacrificed hecatombs of bulls and an infinite number of sheep, loading the altars with aromatics, and pouring out firkins of the oldest and richest wines. He himself led the choruses, and women of his own country danced with him in circles around the altars, while the whole senatorian and equestrian orders stood in a ring like the audience of a theater.

But now he must have a wife for his god. So he broke into the apartments guarded by the vestals and carried to the palace the Trojan Palladium, or what he supposed was that object, and was intending to celebrate the nuptials of the two images. His god, however, he concluded, would not be pleased with a warlike wife like Pallas; therefore, he ordered to be brought from Carthage an ancient image of Urania, or the moon, which had been set up by Dido when she first built old Carthage. With this image he demanded the immense treasures in her temple, and he also collected from every direction immense sums of money to furnish to the moon a suitable marriage portion when married to the sun.

He built another temple in the suburbs of Rome, to which the Emesa stone, the god (?) was carried in procession every year, while the populace were entertained with games, and shows, and feastings and carousings. Herodian thus describes this performance:

"The god was brought from the city to this place in a chariot glittering with gold and precious stones, and drawn by six large white horses without the least spot, superbly harnessed with gold, and other curious trappings, reflecting a variety of colors. Antoninus himself held the reins—nor was any mortal permitted to be in the chariot; but all kept attendant around him as charioteer to the deity, while he ran backward, leading the horses, with his face to the chariot, that he might have a constant view of his god. In this manner he performed the whole procession, running backward with the reins in his hands, and always keeping his eyes on the god, and that he might not stumble or slip (as he could not see where he went), the whole way was strewn with golden sand, and his guards ran with him and supported him on either side. The people attended the solemnity, running on each side of the way with tapers and flambeaux, and throwing down garlands and flowers as they passed. All the effigies of the other gods, the most costly ornaments and gifts of the temples, and the brilliant arms and ensigns of the imperial dignity, with all the rich furniture of the palace, helped to grace the procession. The horse and all the rest of the army marched in pomp before and after the chariot."

The reign of a foolish boy at this period of Rome's history was necessarily a short one, and at the age of eighteen the soldiers killed him and let the Roman populace have the body to drag through the city streets. The worship of the sun god at once ceased, and, no doubt, the stone also was thrown away. The Cybele stone, however, remained an object of public worship, since the quotation from Arnobius, which I have given, was written nearly a century later than the reign of Heliogabalus.

I propose to speak briefly of one more meteorite whose worship has had a world-wide fame: the image of the Ephesian Artemis. This worship had its center at Ephesus, but was widely extended along the shores of the Mediterranean. Temple after temple was built on the same site at Ephesus, each superior to the preceding, until the structure was reckoned one of the seven wonders of the world. As a temple, it became the theater of a most elaborate religious ceremonial. As an asylum, it protected from pursuit and arrest all kinds of fugitives from justice or vengeance. As a museum, it possessed some of the finest products of Greek art, notably works of Phidias and Apelles. As a bank, it received and guarded the treasures which merchants and princes from all lands brought for safe keeping. In its own right it possessed extensive lands and large revenues. The great city of Ephesus assumed as her leading title that of *νεωκόρος*, or temple-warden of Artemis, putting her name on her coins and in her monumental inscriptions.

The image, which was the central object in this temple, was said to have fallen from heaven. Copies of it in all sizes and forms were made of gold, of silver, of bronze, of stone, and of wood, by Ephesian artificers, and were supplied by them to markets in all lands. What a lifelike picture is given us, in the nineteenth chapter of the Acts of the Apostles, of the excited crowd of Ephesians, urged on by the silversmiths, who made for sale the silver shrines of the goddess, and who saw that their craft was in danger if men learned to regard Artemis as no real divinity, and to despise the image that fell down from the sky!

We cannot suppose that the Ephesian Artemis image of the first century was a meteorite, though we have the distinct appellation, Diopetes, fallen from the sky. But I believe that there was a meteoric stone that was the original of the Ephesian images, and it seems not at all improbable that in some one of the destructions of the temple it disappeared. Or, in the progress of time, there may have been a desire to represent the goddess in a more artistic form than the shapeless stone afforded.

Many forms of the Ephesian Artemis are still preserved, and they have, amid all their variations, a certain peculiar character in common. That common character seems to me to confirm the statement that the original image fell from heaven. This goddess is

regarded, let me say, as different from the Grecian Artemis, the beautiful huntress so well known in Greek art, and I am speaking only of the images of the Ephesian Artemis.

There is one peculiarity in the outward forms of the meteorites that is characteristic of nearly all of them. I mean the moulded forms, and the depressions all over the surfaces. They are better appreciated by being seen than by any description I can give you. They are common to meteorites of all kinds, from the most friable stone to the most compact iron. (I show you one, a stone from Iowa—also the plaster cast of another, a stone from some fall, I know not which one.) Those who have lately visited the collection in the Peabody Museum may recollect the model of an iron that fell two or three years ago in Arkansas, which displays most beautifully these depressions.

Let now an artist attempt to idealize any one of these moulded forms, and to make something like a human shape out of one of them. He must necessarily set it upright, and he must give it a head. You have then a head surmounting one of these moulded forms. Let now the convenience and the taste of the artificers of the images have some liberty to act—and we know that they did act, for we have considerable variety in these images—and a development in the conventional representation of the image is sure to follow.

THE KALAMAZOO CARRYCYCLE.

THERE are many people in the world who, on account of ill health, deformity or feebleness, cannot find comfortable means for moving about out of doors. They cannot stand the jolting of a carriage, and, frequently, cannot get in and out of one. The push chairs which are in general use answer quite well, but they can only be moved at a slow rate; they are hard to push, and are not as easy and as comfortable to ride in as might be expected. The vehicle which we illustrate is intended to do away with these objections. The invalid sits in a willow chair and rides along on pneumatic tires close to the ground, with nothing in front to obstruct the view. The vehicle is propelled at a quick or slow pace, as desired, by a person having perfect control of the machine, who can run it anywhere to suit the invalid.

As all the revoluble parts are fitted with ball bearings the friction is reduced to a minimum. The carrycycle has a frame constructed with a drop or low upper bar, so that either a lady or gentleman can ride to propel the machine. As in a vehicle of this kind speed is not much desired, the gear is only 45, 50 or 56, and with a low gear the carrycycle propels very easily. On a steep incline the operator can walk and push the machine with the person in the chair much easier than most push chairs can be pushed. By riding behind, the operator has the occupant of the chair constantly in view, which is decidedly the safest and best position, while the invalid or person in the chair has a clear view in front, which is much pleasanter than riding behind the operator, where the view would be obstructed and every exertion of the operator in plain view of invalid. Again, by having the chair in front the chair can sit close to the ground and tilt forward, so that in order to get into it, all any one has to do is to back up to it and sit down. The operator then brings the chair backward to its normal position and secures it by means of a link or hook. The chair rests on flat U-shaped steel springs, one on each axle, and these springs rest on the front axle of the carrycycle in a manner to allow them to pivot when the chair is tilted.

The steering gear is probably the most interesting feature of the vehicle. The cross bars are coupled at their forward ends by ball bearing heads to the front axle, while the rear ends of the cross bars are coupled by ball bearing heads to the rear frame. The tendency of these cross bars, when pushed together, is to cause the machine to go ahead in a straight line. This makes the machine much easier to steer than can be done by any other method. It also allows the machine to be made much more compact, both as regards width and length, than can be made in other ways. By this construction the front wheel, which carries the load, will

THE KALAMAZOO CARRYCYCLE.

yield while passing over obstructions, thereby making it easier for the load or person riding in the chair than it could possibly with a rigid, unyielding axle for the wheels carrying the load. The carrycycle is also provided with a box or cabinet attachment.

We are indebted to the Kalamazoo Cycle Company for the illustrations and particulars for this article.

MILL SET IN MOTION BY AN OX OR HORSE.

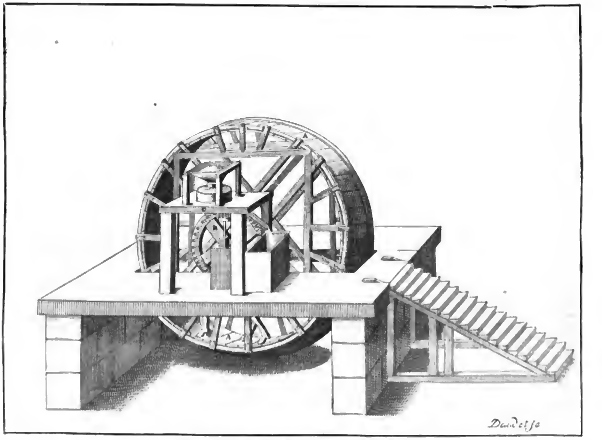
AFTER the large wheel, A, and the rest of the machine shown in the figure has been strongly constructed, an ox that has been previously taught to walk in the wheel is led into it. When the ox effects the motions necessary for walking, he does not change place, but makes the wheel do so; or, to be more explicit, at the part of the circumference upon which his feet rest, he cannot, by reason of the proportion that exists between his weight and the stress necessary to give motion to the mill, move from the line perpendicular to the axis of the wheel in which he is inclosed without causing the latter to revolve.

Thus, the animal, in continuing to revolve the large wheel, A, in this manner, allows the latter to communicate its motion to the face wheel, B, which is at the end of its axle, and consequently to the lantern wheel, C, and the mill stone.—Recueil d'Ouvrages Curieux de Mathematique et de Mecanique, 1733.

AMERICAN MADE MACHINE TOOLS.

ONE of the most important outcomes of the present dispute in the engineering trade will be, it is generally admitted, the development of machine tools in this country. We believe that already not a few firms have under contemplation the design and erection of automatic machinery for doing work which is now done mainly by hand. The anticipated result is that, in place of the arrangement which now very generally obtains of one workman, one tool, one man will, as in America, be able to attend to several tools at once. The innovation will, of course, be opposed tooth and nail by the trades unions, if there is any fight left in them. They have insisted on the one man, one job arrangement, and as they have had the power to enforce, or the masters have had the complacency to grant the demand, few attempts have been made in this country to bring the automatic tool to anything like the perfection that it has attained in the United States notably, and in Germany to a rather less degree. There can be absolutely no question as to the ability of our mechanicians to invent and make the machines as soon as the restrictions on their use are removed. Let anyone who doubts it consider for a moment the automatic machinery of other classes whose birthplace has been in England. Consider only the wonderful machinery of our cotton mills or of our printing establishments. Could not the engineers who have created and designed such highly automatic machinery as this produce, if necessary, tools which as a rule present far less complicated problems? It is unquestionably true that there are in this country hand worked factories into which mechanical methods, one would imagine, might be introduced with advantage. The manufacture of steel pens may be instanced. At Birmingham the work is almost entirely done by girls and old pattern screw stamping presses. It has been stated that this class of work cannot be done automatically. The statement is hardly credible. The fact is in all likelihood that the effect of throwing a large number of persons out of employment is contemplated with dislike. The existence, therefore, of a few cases of this kind in no degree disproves the ability of the Englishman to invent the machinery required.

The use of the machine tool in America is entirely unrestricted. The development of it has, therefore, made great strides. The importation of American tools into this country need not, however, be regarded with the slightest uneasiness. We have not the least hesitation in saying that many English firms can and will produce tools as good as those now being imported. The American tool is not entirely adapted to English work, and in certain respects is distasteful to the British workman. It would not be easy to say why in all cases. The matter is one of taste, just as a Scotchman blows his bagpipes with his mouth while an Irishman blows his with his elbow. Equally attractive music is to be got out of both, but heredity prejudices each nation in favor of a particular type. In other cases it is perfectly easy to account for the Englishman's dislike. One or two of these reasons we may point out. A noticeable feature of American tools is the shortness of crank handles or their replacement by little wheels. We do not question that the American arrangement is designed to give the same power approximately as the English device. To the English mind, however, it does not give the same sense of power and security. Moreover, the control is unquestionably less complete, and the labor is rather increased if any



MILL SET IN MOTION BY AN OX OR HORSE.

thing. Not long ago we saw a large American lathe by a well known firm at work. It was in many respects an excellent tool. The foreman in charge of it said he believed it was a good machine, but nevertheless he did not like it, and never felt quite at home with it. One of his chief objections was that whereas he was accustomed to a long rack handle always well within reach of hand or toe, and having a good, steady working leverage, the tool under discussion had quite a short counterbalanced handle, and not only needed many rotations to run the slide rest back, but, as we have said, left the operator without the sense of the power of controlling his machine. There are other points, too, which a cursory examination reveals. The most potent is the use of a simple instead of a compound rest on lathes fitted with taper gear. Practically all English lathes have two hand screws on the rest, giving motions normally at right angles, one parallel with and the other perpendicular to the lathe centers. The American, however, uses the latter only. Now in English shops the former gear is used universally for adjusting the cut when facing, and the absence of it is consequently embarrassing. The American does the same thing by clamping down the lead nut and turning the leading screw by hand. We do not doubt that very good work can be done in this way—our cousins are excellent mechanics—but it does not strike one as being so convenient as the method to which we are accustomed, and from which we shall not depart readily. Other points in which American and English practices differ will occur to users and makers of machine tools. We think most of our readers will agree with us that the Englishman prefers an English made tool.

We are none the less perfectly ready to admit that American tools are in many respects ingeniously devised and excellently constructed. Makers in this country have much to learn from them; that they will learn much and turn their knowledge to good account we do not doubt for a moment. In making his designs the Englishman will find that the American practice is unsuitable in several respects. It must not be forgotten that American cast iron is a far softer material than ours. Higher speeds and greater feeds can, in consequence, be used than are ever employed here. The very same fact renders alteration in the design of the main castings of a machine necessary. Besides these vital points there are less important details which need observance if outrage is not to be done to the conservatism of English engineers and mechanics. On the whole, therefore, a slavish copy of American tools is as little likely to make much progress in this country as the original tools themselves. We want automatic machine tools, but we want them stamped with our own and not American characteristics.—London Engineer.

NEW GASOLINE MOTORS.

AT the Hungarian Millenary Exposition held recently at Budapest, Messrs. Ganz & Company exhibited some interesting gas motors that are worthy of notice. These motors are of the Banki & Csonk type, with distribution by valves. Those of two horse power especially are now largely used in agricultural exploitations for cutting straw, slicing beets, grinding wheat, churning, etc. They are usually coupled with a pump for raising water.

The gasoline engine represented in Fig. 1 is of the two horse power type. The gasoline reservoir is placed upon the motor and the cooling of the water is effected by means of a fan mounted upon the side of a large iron plate box that carries, in addition, a small centrifugal pump keyed upon the same axle. The suction pipe of this pump descends to the bottom of the box, while the force pipe is connected with the jacket of the cylinder. The forcing of the water, which is heated in contact with the cylinder jacket, is effected through a pipe that starts from the upper part of the box, where it is provided with a rose that divides the water and allows it to fall back in a fine shower. The draught is produced by the fan in an opposite direction and cools the water, which collects at the lower part of the box, whence it is sent anew around the cylinder. It is always the same water that circulates. It is necessary, however, to make additions to it in order to compensate for losses due to evaporation.

The engine that we represent in Fig. 2 is provided with two ten horse power cylinders that actuate a large centrifugal pump. The gasoline reservoir is placed upon the roof of the vehicle, and the cooling is effected directly by means of the pump, the force and suction pipe of which are connected respectively through branches with the cylinder jacket and cover. A small reservoir serves to effect such cooling when the motor is running without the pump.

In the locomotive engines, which operate in most cases in the open air, the suppression of an external flame for ignition is advantageous in every respect.—Revue Industrielle.

TWO HORSE POWER GASOLINE MOTOR.

TEN HORSE POWER GASOLINE MOTOR COUPLED WITH A CENTRIFUGAL PUMP.

PADDLE ENGINES WITH JOY GEAR.

WE publish an engraving of a set of paddle engines constructed by Messrs. Alley & Maclellan, of Sentinel Works, Polmadie Road, Glasgow. These engines, which are noticeable from being fitted with Joy valve gear, are of the triple expansion jet condensing type, and have cylinders 18½ in., 28½ in. and 45 in. in diameter respectively, with 48 in. stroke. They are designed to indicate 600 horse power at 50 revolutions per minute, with a boiler pressure of 150 lb. per square inch.

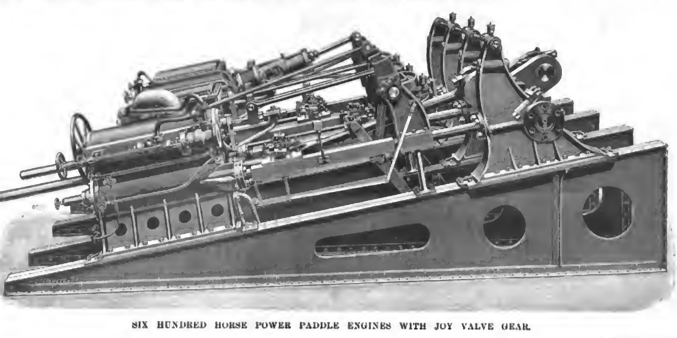
The crankshaft is built of Siemens-Martin steel, and is fitted with Alley's patent flexible coupling. The paddle wheels are of the usual feathering type.

The valve gear is of the Joy radial type, the reversing gear being arranged with steam and hydraulic cylinders worked by a handwheel from the back of the cylinders, arranged in such a manner that combined steam and hand gear, or steam gear only, or hand gear only, can be utilized for reversing purposes.

All the pumps are auxiliary, the feed and bilge pumps being of the duplex type. The air pump is a drum pump driven by a tandem compound engine.

The engines are designed for light draught steamers, the engine frames being built up of steel plates and solid double angle frames, for the purpose of stiffening the hull.—Engineering.

The difference between rising every morning at six and at eight in the course of 40 years amounts to 29,200 hours, or 8 years 121 days and 16 hours, which are equal to eight hours a day for exactly ten years, so that rising at six will be the same as if ten years of life were added.



SIX HUNDRED HORSE POWER PADDLE ENGINES WITH JOY VALVE GEAR.

THE BRIDGES-LEE PHOTO-THEODOLITE.

The idea of using the camera as a surveying instrument has occurred independently to quite a number of engineers, though apparently the honor of being the pioneer in the matter must be conceded to Colonel Laussedat, of the French army. The credit of introducing the system on an extensive scale for the production of topographic plans must, however, be awarded to Mr. E. Deville, the surveyor-general of Dominion lands, who has introduced the method very extensively into his department; no less than 14,000 square miles of territory being thus surveyed during 1893 and 1894, in connection with the settlement of the international boundary between Canada and Alaska. Since then the method has been adopted more or less extensively in the United States, and in its own special department seems likely to oust all rivals. One great advantage of the camera as a surveying instrument lies in the fact that it is much less dependent on the weather than is a plane table, this latter being the particular instrument with which it more especially compares. With the plane table all work must be done in the field, while with the camera, the whole of the plotting being done in the office, the wet and dull days of winter can be used to work up the photographs taken during the finer summer weather. In the Rocky Mountains, Mr. Deville states, plane table work costs at least three times as much as a camera survey. Moreover, with the latter it is possible to make first a rough plot showing only the more prominent features of the ground, and then, if later on a more detailed plan is required, this can be made from the original photographs without necessitating a fresh visit to the ground. As with the plane table, any required degree of accuracy can be obtained by multiplying the photographs taken.

The principle on which the method is based rests upon the geometric truth that if the bearing of any individual object on a photograph from the camera station is known, then the bearing of every other point shown on the print can be calculated, if the focal length of the lens is known. Two photographs being taken of the same landscape from two different stations, and the distance and relative bearing of these two being known, then the whole landscape can be plotted by means of intersections, just as in plane tabling, but with the photographic method the whole of the work can be done at ease in the office.

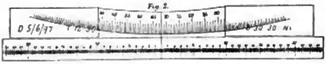
Special cameras have been devised to simplify the work, the essentials being a method of marking on the negative a vertical and a horizontal line intersecting on the axis of the lens. The bearing of the optic axis may be obtained from a compass, and noted at the time the exposure is made. A more convenient method has, however, been devised by Mr. Bridges-Lee, of 6 King's Bench Walk, E. C., who places a compass, having its divisions engraved on a vertical ring of transparent celluloid, inside the camera in such a position that the bearing of the optic axis is automatically recorded on the plate at the same time the exposure is made. A camera thus constructed was described in our issue of July 31, 1896. More recently Mr. Bridges-Lee has made further additions to the instrument, which, as made by Mr. L. Casella, of 147 Holborn Bars, E. C., now takes the form shown in our engraving. The body of the camera is of aluminum, and fits on to a theodolite base below, while at the top is a telescope, small, but of excellent quality, which enables the instrument to be used as an ordinary theodolite when desired, large vertical angles being observed when necessary by a prism or mirror attachment. The divided horizontal circle enables azimuth readings to be made to half a minute of arc, a vernier and reading microscope being fitted as shown. The latter is carried on a telescopic arm and can also be used for reading the compass bearing through a window in the focusing screen. The level shown at the top of the camera moves on a circular run, and enables the instrument to be leveled without necessitating the turning of the camera as a whole. Inside the camera is a frame sliding on ways, and carrying in the first place the compass already mentioned; and, secondly, the cross wires, which by their shadows mark on the negative the principal vertical and horizontal lines of the picture. When a slide is in place and the shutter withdrawn, the frame already mentioned is moved up by the milled head shown to the right of the camera, until its edges are in contact with the sensitive plate. The latter is then carried back with the frame until further motion of the latter is arrested by fixed stops, so that, whatever the thickness of the plate, the distance of the sensitive surface from the lens is always the same. The cross strip shown attached to the back of the frame is of glass, and carries an accurate tangent scale, which enables the horizontal angle which any object shown on the print makes with the optic axis to be determined directly by the use of a parallel ruler or a pair of dividers. The two little strips of celluloid shown below and at either end of the tangent scale are removable, and on them can be written previous to taking the photograph such data as the camera station, its number and elevation, date, etc., all of which will then be reproduced on the negative, and thus any possible danger of confusing two negatives on the subsequent plotting is totally avoided. The information recorded on a negative in this way is shown in Fig. 2, which is reproduced on the sky of each negative. The lens adopted is of the rectilinear type, and is used with a fixed focus and a very small stop. In order to avoid photographic haze, which tends to render distant objects indistinct, isochromatic plates and a yellow or green screen are made use of, and with this precaution there is no difficulty in getting sharpness in the "distance" of the picture.

To secure the stability of the instrument during the long exposure entailed by the use of this screen and the small lens aperture adopted, it is usual in Canada to carry a net, which is hung on the camera tripod when set up and filled with stones, the precaution being taken of letting the bottom of the net just scrape the ground, as otherwise it would swing with the wind and cause shaking.

Having obtained a plan of a survey in the way described, the introduction of contour lines is not difficult, since the distance of any particular point from the camera station is then known, and its depth above or below the horizon line in the print is a measure of its angular elevation or depression as observed from the camera station. The level of a few points being thus ascertained, the contours can be filled with considerable accuracy by estimation from the appearance of the photograph.—Engineering.

Fig. 1.

Fig. 2.



THE BRIDGES-LEE PHOTO-THEODOLITE.

LABELS FOR DRY PLATES.

Probably a considerable number of readers will now be planning their Continental trip, and there will be even among the oldest travelers a certain amount of fear—"Shall I get my plates through safely?" Especially will this be so if one's vocabulary is bounded by the "Have you the pens, ink, and paper?" limitations, which with the aid of native hospitality may be sufficient to provide the necessaries of life when once we are in the country itself, but will scarcely enable us to explain the contents of that mysterious parcel of plates or films to the Custom House officials. The best way then is to have a few labels printed and gummed so that they may be stuck on to each package of sensitive material, and which, with the truthful expression which the photographer always wears, *will* satisfy the officers that no dynamite, or tobacco, or matches, or tea, or India rubber soled boots are being smuggled in. Here is a list of the inscriptions for the various countries:

FRENCH.

CRAINT LA LUMIERE.
N'OUVRIR QU'EN PRESENCE DU DESTINATAIRE.

GERMAN.

FURCHET DAS LICHT.
NUR ZU OFFNEN IM GEGENWART DES EMPFANGERS.

ITALIAN.

TEME LA LUCE.
APRIRE IN PRESENZA DEL DESTINARIO.

NORWEGIAN.

MAA IKKE UDSOETTES FOR DAGSLYSET.
OG KUN AABNES I ADDRESSATENS NORVOERELSE.

SPANISH.

TEME LA LUZ.
ABRIR SOLO EN LA PRESENCIA DEL DESTINATARIO.

DUTCH.

MAGNIET AAN HET DAYLICHT BLOOTGESTELD WORDEN. VERZOEKE NIET TE OPENEN DAN IN TEGENWOORDIGHEID VAN DEN GEADRESSEERDE.

—The Amateur Photographer.

ON GAMBIER-FLUORESCIN AND GAMBIER-CATECHU RED.

By Karl Dieterich.

The author has stated before that gambier-catechu, in contradistinction to pegu-catechu, contains a fluorescent body whose character he now describes more closely. The same is called gambier-fluorescin and is of a highly decomposable nature, for which reason it could not be obtained isolated pure, but only in solution. It is a basic body, which passes into a red resin by oxidation in the air, which Dieterich names gambier-catechu red. The gambier-fluorescin is not con-

tained in a free stale in the catechu, but is apparently combined with catechine and catechu tannic acid, in the same way as ester. By carbonic or caustic alkalies, however, it is readily split off and can then be shaken out with benzine or ether, besides two other bodies of an oil like and waxlike nature. The gambier-catechu red is not similar to pegu-catechu red already known. It melts at 130–131° C., is almost insoluble in ether, and is no longer, like the fluorescin, of purely basic character. It can be acetylized and has a percentage of acid of 95·2, while the ester number was 30. Owing to the fact that only 1 gramme of catechu red could be obtained from 5 kilogrammes of gambier, the investigation has not very far advanced.

The fat oil above mentioned contained 14·89 per cent. of acid and 43·33 per cent. of ester, while the percentage of iodine is exceedingly small. The small quantity of this substance, as well as of the wax also present in catechu, makes a more accurate examination impossible for the time being.—Ber. Pharm. Ges.

THE CHIME AT ST. GERMAIN L'AUXERROIS.

FORMERLY, when church chimes were rung by hand, it was always effected by maneuvering the clappers inside the bells by the aid of pedals and of keys arranged on a sort of keyboard.

The old automatic system consisted of a metallic cylinder covered with numerous projecting pins, and rotated by a clockwork movement. In revolving, this cylinder raised, by means of the pins on its surface, the levers, which were connected by wires with the clappers; and the latter, on falling back against the bells, produced the tones necessary to play the desired airs.

When it was desired to obtain very powerful tones and to play tones of some length, an enormous power had to be expended. By the aid of the keyboard and its attachments it was necessary, in fact, to raise clappers, which in some cases were extremely heavy, and to overcome a resistance that could be surmounted only by great trouble, and that too by striking with the fists on the keys and with the feet on the pedals. (Fig. 1.) When the automatic cylinder was employed, it was necessary (owing to the fact that it had to raise heavy clappers) to give it dimensions varying from 3½ to 6½ feet in diameter, and a very considerable rotary power. To actuate these machines, weights of from 1,000 to 6,000 pounds were employed. These were suspended from chains rolling around drums, and were wound up by means of windlasses, requiring the labor of from one to three men for one or two hours. The chime of the Samaritaine, at Paris (destroyed in 1813), was on this system. At Bruges, Belgium, there is a very perfect chime of the same kind. It is provided with a bronze cylinder weighing no less than 22,000 pounds, and representing a value of $8,000 for the metal alone. These old fashioned chimes, as may well be seen, were very costly and inconvenient. They utilized at the very most only 30 per cent., or at the least one third of the force expended. This will be readily understood if it be taken into consideration tha[illegible]r, always revolving with the same spe[illegible] much power to sound a 6 pound bel[illegible] large one weighing 6,000 pounds.

T[illegible]e tower of Saint Germain l'Auxerrois, at [illegible] essentially from those above described [illegible]s a great progress in the manufacture [illegible]aratus. It consists essentially of: (1) sets of wheels and weights equal in number to that of the bells and of power porportionate to the weight of the latter; (2) of a keyboard similar to that of a piano and operated the same way; (3) of a cylinder for playing automatically, of about 16 inches diameter, so arranged that it can be removed and replaced by others affording other tunes. The importance of the revolution effected in the mechanism may be realized when we state that this chime, instead of needing the labor of two or three men during a part of a day for winding it up, requires but the labor of one man for ten minutes each week to wind up the weights connected with the automatic part, which is arranged to play four airs per day. Fig. 2 shows the chime as now definitely located in the tower of St. Germain l'Auxerrois.

In the old system of chimes there was but one mechanism for all the bells, but in this each bell has a special set of motive wheels of a power proportioned to the weights. As each set of wheels can operate only when it is desired to obtain the sound of the bell connected with it, it uses its power only when it acts. The manufacturer has based his calculations of the motive weights on data from experiments, which have shown that, in large bells giving the bass tones in the chimes, the effort necessary to raise the clappers is about equal to a hundredth of the weight of the bells; a bell of 4,000 pounds, for example, requiring an effort of 40 pounds. But in the small bells the effort is relatively greater in proportion to their weight, and may be estimated at about one-fifth; so that for a bell of 20 pounds, for instance, an effort of 4 pounds would be necessary. As may be seen, then, this division of the weights and sets of wheels affords considerable economy in motive power. This arrangement, moreover, has the advantage that the wheels operate with sufficient speed to allow passages to be readily played which contain quavers and semiquavers.

Finally, it may be remarked that one of the characteristic features of this chime is that the operations of the automatic cylinder are effected without any outside aid—the mechanism once wound up taking care of itself.

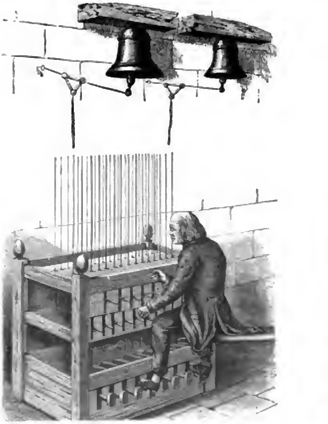


FIG. 1.—KEYBOARD CHIME—OLD SYSTEM.

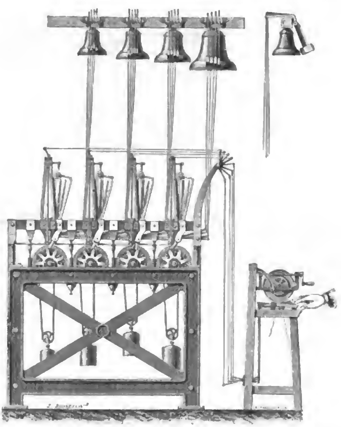


FIG. 2.—NEW CHIME OF SAINT GERMAIN L'AUXERROIS.

DETECTION OF TAR DYESTUFFS IN CLARET.

SULPHIDE of zinc forms a very stable lake with the dyestuff of wine, of bilberries, mallows, as well as with archil, litmus and cochineal, while tar dyestuffs can be very easily abstracted from the mixture with alcohol or water. This behavior of the sulphide of zinc forms the basis of a new method of isolating tar dyestuffs from claret. Not every sulphide of zinc can be used. Most advantageous was found the preparation which is obtained from a chloride of zinc solution mixed with ammonia in excess by precipitation with a sufficient volume of sulphide of hydrogen. The precipitate is washed until free from chlorine and dried at a temperature kept below 35° Cent. To test claret for tar dyestuffs, grind five grammes of sulphide of zinc in enough wine so that a scarcely liquid mixture ensues, then add a little water until the mixture is fluid; allow to deposit, filter and abstract. In case the fluid appears colored, elute the dyestuff by washing with water. The colored filtrate is evaporated, the residue extracted with 90 per cent. alcohol, and the filtered solution once more evaporated to dryness. The dyestuff can now be dissolved with alcohol and used for identity reactions. If the dyestuff of the sulphide of zinc-wine mixture does not pass into the water, treat the filter residue again moist with the same volume of 90 per cent. alcohol, heat moderately while stirring, filter and abstract the dyestuff by washing with alcohol. Indigo carmine, which can be isolated by means of water, behaves in the same manner as tar dyestuffs. Alcohol, however, easily abstracts them if they are soluble in it. Otherwise a like volume of alcohol is poured over the moist precipitate in a porcelain dish, in such a manner that the mixture does not wet the walls above it of the vessel. If the liquid is evaporated without stirring, dissociation of the lake will set in and the dyestuff will adhere to the wall of the dish. The evaporation is continued to dryness, the sulphide of zinc removed from the dish and the dyestuff dissolved with water. This abnormal behavior was observed only with three blue tar dyestuffs. According to the described method it can be readily ascertained whether fuchsine or a sulphur acid is present, as the latter is already soluble in water; fuchsine, however, only in alcohol. For the identification of the different dyestuffs the author has compiled an extensive table.—Chemiker Zeitung, from Rev. Chim. Anal. Appliq., 1897, 5, 62.

METHOD OF PRODUCING INCANDESCENT MANTLES.

SUCH a mantle is obtained, as has been shown by the incandescent light patent suits (Chem. Ind.), by saturating the knit cotton hose with a 30 per cent. solution of the nitrates of thorium and cerium (99 : 1), drying in the air and incinerating. The ashes at first are entirely soft and flexible; by annealing by means of suitably shaped pressed gas burners the substance is caused to slag and harden, and at the same time it is given the bell-like shape. Now the mantle is hung up, by means of an asbestos thread drawn through its head, upon a magnesia pencil in the middle of the burner (commonly iron pencils were used). To take the place of the magnesia pencils, of late pencils of fire clay have been introduced in the market; as the former, being made of finely ground magnesite and exposed to strong white heat, frequently slake in damp air and consequently quickly crumble into dust. The highest illuminating power of the mantles is dependent on the proportion of aluminum 99 and cerium earth 1. An increase of the percentage of cerium changes the white light of that mixture more and more into yellow; pure nitrate of thorium is luminous in the Bunsen flame only with a dead, red-violet, pale light; likewise nitrate of cerium alone or mixed with up to 70 per cent. thorium only gives off a dark, blood-red to orange-red light. Important is the production of pure salts of thorium and cerium, which are at present prepared from the monazites. The separation of cerium from didymium and lanthanum is considered particularly difficult, and for this purpose Mozander's process, modified by O. N. Witt, is recommended. The raw dioxide of cerium thus obtained is dissolved in nitric acid, nitrite of ammonium added, and the nitrate of ceriammonium is allowed to crystallize out. These orange-red crystals, reduced in an aqueous solution with alcohol and evaporated, yield the beautifully crystallizing ceriammonium used in mantles as nitrate of cerium.

Rhinometers are devices to measure the amount of air a man breathes through his nose, in order that his doctor may compare it to the amount he should take in that way.

SELECTED FORMULÆ.

Soldering Aluminum.—Another new solder for aluminum has been brought out in the United States under the title of Green's aluminum solder. It is stated to be composed of zinc, 59·03 per cent.; tin, 47·99; aluminum, 1·76; and phosphorus, 0·22 per cent. It is not used with any flux, simply requiring the aluminum faces to be cleaned and coated with the solder, then a clean hot bit is used to wipe the joint to be made.

Tanning Hides for Robes.—The hides should be very thoroughly soaked in order to get a complete softening. For dry hides this will require a longer time than for salted. A heavy hide requires longer soaking than a skin. Thus, it is impossible, says Hide and Leather, to fix a certain length of time. After soaking, the hide is fleshed clean, and is now ready to go into the tan liquor, which is made up as follows: One part alum, 1 part salt, ½ to ¼ part japonica. These are dissolved in hot water in sufficient quantity to make a 35° liquor. The hide, according to the thickness, is left in the tan from five to ten days. Skins are finished in about two or three days. The hide should be run in a drum for about two hours before going into tan, and again after that process. In tanning hides for robes, shaving them down is a main requisite for success, as it is impossible to get soft leather otherwise. After shaving put back into the tan liquor again for a day or two and hang up to dry. When good and hard, shave again and lay away in moist sawdust and give a heavy coat of oil. When dry, apply a solution of soft soap; roll up and lay away in moist sawdust again. Now run the hides on a drum or wheel until thoroughly soft. The composition of the tan liquor may be changed considerably. If the brownish tinge of the japonica be objectionable, that article may be left out entirely. The japonica has the effect of making the robe more able to resist water, as the alum and salt alone are readily soaked out by rain.—Shoe and Leather Facts.

Spots on Cigars.—The speckled appearance of certain wrappers is due to the work of a species of fungus that attacks the growing tobacco. In a certain district of Sumatra, which produces an exceptionally fine tobacco for wrappers, the leaves of the plant are commonly speckled in this way. Several patents have been obtained for methods of spotting tobacco leaves artificially. A St. Louis firm uses a solution composed of:

Sodium carbonate	3 parts.
Calx chlorinata	1 "
Hot water	8 "

Dissolve the washing soda in the hot water, add the chlorinated lime and heat the mixture to the boiling temperature for three minutes. When cool, decant into earthenware or stoneware jugs, cork tightly and keep in a cool place. The corks of jugs not intended for immediate use should be covered with a piece of bladder or strong parchment paper, and tightly tied down to prevent the escape of gas, and consequent weakening of the bleaching powder of the fluid. The prepared liquid is sprinkled on the tobacco, the latter being then exposed to light and air, when, it is said, the disagreeable odor produced soon disappears.—American Druggist.

Development of Fruit Flavors.—Some very interesting and suggestive results have been obtained by Jacquemin, who finds that by the addition of the leaves of fruit trees, which in themselves have no marked flavor, to saccharine solutions undergoing alcoholic fermentation, a very marked bouquet of the fruit is developed. Thus by immersing pear or apple tree leaves in a 10 or 15 per cent. solution of sugar, and adding a pure yeast, which by itself gave rise to no marked flavor, after fermentation a liquid was obtained which had a strong odor of pear or apple respectively and an excellent flavor, and on distillation gave an alcoholic distillate, in which this aroma was still more marked. Vine leaves act in a similar manner, and the author suggests that it may be possible to improve the bouquet of a poor vintage by the addition of some leaves during fermentation. It is noteworthy that the results are far more marked when the leaves employed are from trees in which the fruit is approaching maturity. The author infers that the flavors of fruits are due to a body elaborated in the leaves, possibly of a glucosidal nature, which is not transferred to the fruits until the latter approach maturity, and is then acted upon by the special ferments contained in the fruit juices and develops distinctive flavors. The matter would appear to be of considerable practical importance.—Pharmaceutical Journal.

An Ever-Ready Pad for Rubber Stamps.—The following is said to be a cushion that will give color permanently. It consists of a box filled with an elastic composition, saturated with a suitable color. The cushion fulfills its purpose for years without being renewed, always contains sufficient moisture, which is drawn from the atmosphere, and continues to act as a color stamp cushion so long as a remnant of the mass or composition remains in the box or receptacle. This cushion or pad is too soft to be self-supporting, but should be held in a low flat pan and have a permanent cloth cover. The composition consists preferably of 1 part gelatine, 1 part water, 6 parts glycerine, and 6 parts coloring matter. A suitable black color can be made from the following materials: 1 part gelatine glue, 3 parts lampblack, aniline black, or a suitable quantity of logwood extract, 10 parts of glycerine, 1 part absolute alcohol, 3 parts water, 1 part Venetian soap, 1·5 part salicylic acid. For red, blue or violet, 1 part gelatine glue, 2 parts aniline of desired color, 1 part absolute alcohol, 10 parts glycerine, 1 part Venetian soap, and 1·5 part salicylic acid. The following are two additional receipts used for this purpose: 1. Mix and dissolve 2 to 4 drachms aniline violet, 15 ounces alcohol, 15 ounces glycerine. The solution is poured on the cushion and rubbed in with a brush. The general method of preparing the pad is to swell the gelatine with cold water, then boil and add the glycerine, etc.

Formaldehyde for Mosquitoes.—Dr. Henry Liston, of Sunderland, states that while on the Zanzibar coast he used a 40 per cent. solution of above for mosquito bites with remarkably quick and good results. It should be applied to the bites as soon as possible with the cork of the bottle, and allowed to dry on.—Western Drug.

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THE MANUFACTURE OF ABORIGINAL STONE IMPLEMENTS.

THE origin of a primitive industry is usually shrouded in obscurity, and the narration of the attempts to gather the scattered fragments and build up a picture of early industry is interesting not only to the archæologist, but to the general reader as well. In the Fifteenth Annual Report of the Bureau of Ethnology to the secretary of the Smithsonian Institution, 1893-94, is a most interesting paper on "Stone Implements of the Potomac-Chesapeake Tidewater Province," by William Henry Holmes. Through the courtesy of the director of the Bureau of Ethnology, we are enabled to present a few of the interesting engravings with which the paper is so well illustrated. As the original monograph occupies some 150 pages, all of the details of the explorations will have to be omitted and we shall confine ourselves only to the general conclusions which are adduced.

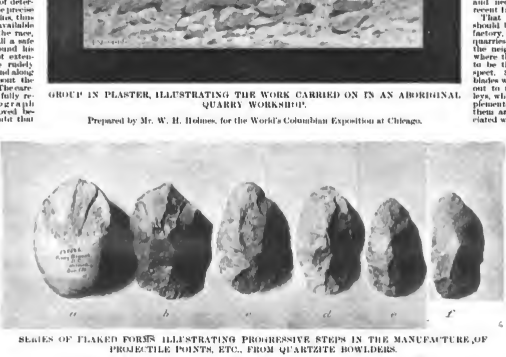
The Indian tribes inhabiting the great province drained by the tidewater tributaries of the Chesapeake were simple fishermen, hunters and warriors, whose art aimed little beyond the supply of pressing needs, and the district now furnishes almost nothing in the way of art remains to attract the popular eye. Little has been preserved beyond the simplest varieties of stone implements; but inconspicuous and elementary as these objects are, they have attracted much attention on the part of archæologists and are now eagerly studied because of their bearing, not only on the history of the region and its people, but on questions of general import in the history of primitive progress. The explorations and studies recorded in the exhaustive paper we have referred to above were for the purpose of determining, if possible, the precise status of these remains, thus making them safely available to the historian of the race, who seeks first of all a safe basis on which to found his structure. The most extensive deposits of the rudely flaked stones were found along the bluffs in and about the city of Washington. The careful investigation so fully recorded in the monograph named above has proved beyond a shadow of doubt that the great deposits are on the sites of workshops connected with extensive quarries where the raw material (cretaceous bowlders) was obtained. It was further found that the widely scattered specimens of the same class were on sites (village sites or otherwise) yielding less plentiful supplies of the available raw material where manufacture had been conducted on a smaller scale. That the vast body of the rudely flaked stones of the province are rejects of manufacture was readily shown.

GROUP IN PLASTER, ILLUSTRATING THE WORK CARRIED ON IN AN ABORIGINAL QUARRY WORKSHOP.

Prepared by Mr. W. H. Holmes, for the World's Columbian Exposition at Chicago.

As a second step in the investigation it was deemed necessary to determine the exact relation of these objects with the real implements of the region. This was accomplished by first determining, by most careful studies of the rejectage of the great flaking shops, just what the product of the flaking operations was. This product, so far as the progress of specialization of form on the shop sites indicates, was found to be a leaf-shaped blade. A third step in these explorations was then undertaken for the purpose of determining the destiny of these blades—where they were carried and how and by whom used. Many specimens of identical form were found on Indian village sites in all parts of the surrounding region and in several cases on sites of historic Algonquian settlements, where they were intimately intermingled with the midden refuse, pottery, and neolithic implements. It was further discovered that a large percentage of the countless stone implements—knives, spearheads, arrowpoints, etc.—found in the broad valley below were of leaf-shaped genesis; that before they received their final shapes by trimming, stemming, and notching, they had been blades corresponding exactly with those produced in a multitude of shops. The shops are, therefore, a necessary complement of the implements of the region, and the implements a necessary complement of the shops. The shops, great and small, are thus definitely connected with the great body of implements of the region, and these implements are directly connected with the dwelling sites of the historic peoples. The practical unity of the stone art of the region is in this way fully established, no type of implement or shaped stone not being fully accounted for by the well established facts and necessary conditions of recent Indian occupancy.

That these demonstrations should be complete and satisfactory, studies were made of quarries of other materials in the neighboring highland where the conditions proved to be the same in every respect. Similar leaf-shaped blades were made and carried out to the surrounding valleys, where they and the implements specialized from them are found closely associated with the more local art products.



SERIES OF FLAKED FORMS ILLUSTRATING PROGRESSIVE STEPS IN THE MANUFACTURE OF PROJECTILE POINTS, ETC., FROM QUARTZITE BOWLDERS.

About one-third actual size. Obtained from shops and villages about Washington City.

It must be regarded as a striking circumstance that a large part of the varied phenomena considered in the monograph are assembled within two or three miles of the capital of the nation, much of it being within the capital city or within the area over which the city streets are now laid out. The greatest aboriginal bowlder quarry known, and the most important implement shops yet observed on the Atlantic slope, are located on Fourteenth Street, two and one-half miles from the Execu-

tive Mansion. Until recently it was hardly suspected that the Potomac-Chesapeake province was so rich in ancient remains. The arts and industries of the historic aborigines were extremely simple, and no striking monument or remains of any kind are found to tell of vanished peoples. Careful exploration has, however, developed evidences of an intelligence and enterprise hardly to be expected of tribes of indolent savages. The use of stone by the prehistoric aborigines was limited to the manufacture of implements and utensils, but their knowledge of the mineral resources of the region was so extensive that no deposit of bowlders, no ledge of flakable stone, no deposit of available stone of any kind, seems to have escaped their attention. Quarrying and manufacture were extensive, and the distribution of the product extended in several cases for a hundred miles or more beyond the source of supply.

The historic tribes of the region are mainly of the Algonquian linguistic stock, the stock of Powhatan and King Philip, and this notable people may be connected by means of the art remains of their numerous village sites with the great body of ancient inhabitants whose domain extended from South Carolina to Nova Scotia. There are some traces of departure from ordinary Algonquian types of art, but these are not decided enough to warrant the assumption that other peoples of independent culture were directly concerned. The culture status indicated by the remains here brought to the attention of students is precisely that of the historic inhabitants encountered by John Smith.

The explorations embodied in this monograph began in 1889 and continued with much interruption until 1894. It is evident from this that the field has been imperfectly covered, for the tide water Chesapeake country comprises upward of 20,000 square miles of territory, nearly every mile of which abounds in important traces of ancient aboriginal occupancy. To visit all and examine all would require a good part of a lifetime. Realizing this, the method was adopted of passing rapidly over the various sections and selecting a few typical examples of each class of sites or groups of phenomena for minute examination. The detailed studies made of these sites serve in a great measure to illustrate the whole subject, and though imperfect in many ways, form nuclei about which additional details can be assembled as they are acquired.

Stone exists in many varieties, forms, and conditions, which differ greatly in the various sections of the country, thus giving much diversity to the manner of its utilization and to the forms employed in art, and many local peculiarities of art phenomena have arisen. Moreover, the tribes of this region were not fully sedentary, and the materials acquired in one section were carried into another, giving rise to much variety in the materials employed by a single people or assembled in a given place. This complexity was also increased to some extent by trade, and no doubt by the undertaking of long journeys for the purpose of securing desired materials. Transportation was confined mainly to the smaller and more laboriously finished articles of use. Unshaped raw materials were not extensively transported, and the large body of the heavier tools and utensils made where material was plentiful were deserted when the locality was abandoned.

The great rivers of Mesozoic and Cenozoic times swept down from the highlands, bearing fragments of all varieties of rocks and depositing them in beds along the margin of the sea. These transported fragments were, when first taken up by the water, sharp and rugged, but by constant rolling they were reduced to rounded forms, and included all sizes from grains of sand and minute pebbles to bowlders and even to great masses. All classes of rocks were thus seized by the floods and carried seaward; but all varieties did not reach the sea, save perhaps as sand or clay. The softer rocks were reduced to powder before the journey was fairly begun; brittle and much flawed varieties, and all friable shales and slates, separated into minute fragments and formed beds of sand and gravel; the tough, hard, homogeneous pieces were rolled and rounded and carried ever onward, refusing to break or to be reduced to dust, and finally rested along the seashore and more especially about the mouths of the great rivers.

The primitive inhabitants of the crystalline highland had to make use of massive forms of rock or of rude angular or slightly waterworn fragments, and the reduction of these to available sizes and forms was a difficult work. But the inhabitants of the lowlands were born to more fortunate conditions. The agents of nature—the floods—had, with more than human intelligence and power, selected the choice bits of rock—the tough quartzite, the flinty quartz, the tough and brittle lavas, the indurated slates, the polished jasper and the beautiful flints—from all the cliffs and gorges of the mountains and had reduced them to convenient sizes and shapes and had laid them down in beds of the shallow estuaries, where, through the subsequent rising of the land and the cutting of the valleys, they were found at the door of the tidewater lodge.

It will be readily seen that these conditions of mineral resources must have had a marked effect on the art of the region and thus on the culture of the natives inhabiting it. One drainage area supplies quartz mainly and the art is quartz art; another supplies quartzite and the art is quartzite art, and so on.

Quarrying begins with the removal of a fragment or mass of material partially buried in the ground. It is but a step further to the uncovering and removal of portions wholly buried, and only another step to quarrying on a large scale. The methods and extent of the quarrying necessarily differed with the peoples and their circumstances, with the nature of the material and with the conditions under which it existed.

Of the details of quarrying operations our knowledge is yet imperfect, though much has been learned in certain directions; and of the tools used in quarrying, aside from those made of stone and left on the sites, no definite information has as yet been obtained. It is quite likely that implements of wood, buckhorn, and bone were used, as in foreign stone age quarries, but traces of these have wholly disappeared from the sites thus far examined. Fire may have been used in some localities as an agent in fracturing masses of stone, but the tidewater region furnished little material, save perhaps quartz, suitable for manipulation by this means. Massive forms of rock are found west of the fall line or western border of the tidewater country. Flint, jasper and rhyolite were quarried far back in the highland, and vein quartz was found, and no doubt to some extent quarried, in a multitude of places over the whole Piedmont region, and down to and even below the margin of the tidewater area. Steatite or soapstone is a tough, massive rock interbedded with gneissic formations, and rarely occurs in detached masses. In the beginning of its use it was secured where exposed on the surface by prying off small masses. The lumps thus secured were ready for the sculptor's chisel. In time quarrying developed and was extensively carried on in many parts of Virginia and Maryland beyond the tidewater border.

The surface or float cobbles were extensively used, but the aborigines came to need more than could thus be obtained, and resorted to digging them from their places in the bluffs. The implement makers seem to have found that the freshly removed stones were more easily worked than surface finds, and quarrying, thus encouraged, was carried, in at least two places, over acres of ground. The bowlders were not always easily loosened and removed, as the rounded stones were held together by a matrix of sand and clay which had assumed the consistency of a sandstone; but the miners did not always penetrate the formation from above or even directly from the face of the outcrop. It happened that in many cases the bowlder beds rested on a surface of disintegrated gneiss exposed in bluff slopes, and by removing the upper surface of this with such pikes as were at hand the bowlders were undermined and easily knocked down. So far as observed, the bowlder deposits containing workable stone in any considerable quantity rest on the gneissic surfaces where they were laid down by the waters of the ancient sea.

Quartz, which was more generally if not more extensively used than any other material, is found in two forms. It occurs in countless veins which penetrate the gneissic rocks over a large district west of the fall line. Being much less destructible than the gneisses, it weathers out in dikelike ridges and breaks up into blocks and angular pieces which spread over the ground in vast numbers. Choice varieties of this vein rock were, without doubt, quarried to some extent, but it was so plentiful on the surface that quarrying was not generally necessary. Carried down by the streams of all periods, it occurs plentifully as pebbles and bowlders in all formations in the watertide region, and was selected or quarried along with the quartzite.

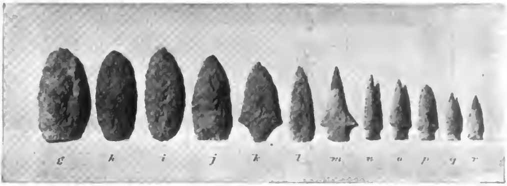
Jasper, flint, rhyolite and other varieties of stone were rather rare within the tidewater districts, occurring sparingly as pebbles, small bowlders and worn fragments in gravel deposits and in the beds of rivers. They were procured, however, by the tidewater tribes from masses in place in the uplands and mountains, the quarries being quite extensive.

Having secured the raw materials from the surface or by quarrying, the next step was either to utilize them unchanged or to shape them for use.

Sharp-edged and pointed stones were used for cutting, digging, etc., and rounded cobbles from the river or from gravel beds were well suited for striking, pounding, grinding, etc. But with these unmodified forms we have little to do, as it is not easy to say that any given specimen was used at all, unless it bears decided marks of use; and decided marks of use may be regarded as giving the object an artificial form, as in the case of the improvised mortars, mullers and hammer stones so common in the Chesapeake-Potomac region.

The shaping processes, by means of which stones were made to assume artificial forms adapted to human needs, are varied and ingenious, and their mastery is of the greatest importance to all primitive peoples. These processes are distinguished by such terms as breaking, flaking, cutting, drilling, scraping, pecking, grinding and polishing. All are purely mechanical; none are chemical, save a possible use of fire to induce changes in the rock in some parts of the quarry work.

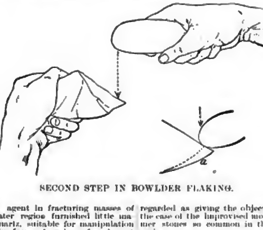
The wide range of manual operations is represented, and these may be conveniently arranged in four



SERIES OF FLAKED FORMS ILLUSTRATING PROGRESSIVE STEPS IN THE MANUFACTURE OF PROJECTILE POINTS, ETC., FROM QUARTZITE BOWLDERS.

About one-third actual size. Obtained from shops and villages about Washington City.

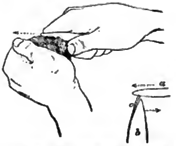
FIRST STEP IN BOWLDER FLAKING.



SECOND STEP IN BOWLDER FLAKING.

groups: 1, fracturing, represented by the terms breaking, flaking, and chipping; 2, incising, including cutting, picking, and scraping; 3, battering, including such acts as bruising, pecking, and hammering; 4, abrading, as in rubbing, drilling, boring, sawing, and polishing. These acts are employed according to the nature of the stone or the results desired; as for example, fracture is employed where the stone to be shaped is brittle, like flint, jasper or quartz; incision is employed where the stone is relatively soft, such as soapstone, serpentine and the like; battering is applied to tough materials, capable of resisting the shocks of percussion, like granite rocks and many of the eruptives. Nearly all varieties are capable of being shaped by grinding and rubbing.

The processes employed in a given piece were determined by the nature of the material, by the intelligence and skill of the workman, by the character of the subject designed, and by a number of minor considerations. Ninety per cent. of the stone implements produced in the tidewater country were shaped by the



FLAKING BY PRESSURE, A BONE IMPLEMENT BEING USED.

a, the bone tool; b, the stone; c, the flake.

fracture process. For convenience of treatment the subject is divided into three sections, which have been noted above. The fourth or abrading process being mainly auxiliary to the others. We will now take up the consideration of fracturing or flaking. The art of flaking stones was extensively practiced in the tidewater region, where ample opportunity is afforded for observing the work in all its stages. The first step in the process, where masses were dealt with, consisted in breaking the material by heavy blows into somewhat approximate shapes and sizes; the second step was roughing out by freehand percussion the blank forms of the various classes of tools desired. The third step was the specialization of forms by direct or indirect percussion or by pressure. It was found convenient and profitable for certain individuals to give exclusive attention to the separate steps—first, quarrying, breaking up the material and selecting pieces in large numbers; second, to roughing out the blank forms and numbers; and third, to the work of trimming, specializing, and finishing. These three well defined steps gave rise to a separate industry, carried on by the same individuals at different times or stages or by distinct groups of experts at convenient times and places. It would seem that the first and second steps, whether performed by one or two groups of workmen, were generally accomplished on the spot yielding the raw material; it would be unprofitable to transport masses of material of which nine-tenths would finally have to be consigned to the refuse heap. The blank forms of the articles to be shaped, worked out so far as thoroughly to test the material and its capacity for specialization, were removed from the source of supply to be finished when convenient or when need demanded.

Where disseminated materials were utilized, and especially in cases of immediate need, all the steps were frequently taken and the perfect implement produced at once; but it is observed that in many cases where the material was sparsely scattered as bowlders or nodules over the face of the country, the work of collection and blocking out was first attended to and the hoards of blanks thus produced were transported and stored, subject to final distribution for specialization or use.

As has been indicated, flaking was employed almost exclusively in the production of projectile points, knives, scrapers, perforators (or drills), hand axes or choppers, notch axes, hoes and picks; it serves to aid in roughing out the forms of various articles finished by pecking and grinding; these are mortars, pestles or mullers, axes, celts, chisels, types, ornaments, and diversional and ceremonial objects.

The flaking tools were probably bowlders selected for the purpose from the multitude of available examples; though few were found that show any considerable evidence of wear, many specimens occur which were more or less battered, apparently by use. With multitudes of natural hammers of choice shape and assorted sizes at hand, it was manifestly useless to shape special tools or to bring in shaped tools from the outside.

The first step after the removal of the bowlders from the bed by the quarryman was to test them for quality of material. As a rule, the removal of a single flake, or at most a very few flakes, enabled the expert workman to determine whether or not the stone was reasonably tractable. The selected material was removed to the shop sites, where the flaker took up the work. The process of flaking appears to have been exclusively fracture by free-hand percussion, the act being a quick, firm stroke, regulated in force by the nature of the resistance to be overcome and by the result observed. The bold but unsymmetric outline of the forms produced and the rather haphazard arrangement of the percussion points preclude the idea that any process capable of accurately adjusting the point of contact between the tool used and the article shaped could have been employed. At best such a method would certainly not be readily applicable to a stone of the refractory nature of quartzite. Though the manner of delivering the strokes seemed sufficiently determined, the precise method of holding the stone shaped is left to conjecture. My own experiments, says Mr. Holmes, have been conducted upon the assumption that it was held in the hand. The account of flaking processes given in the following paragraphs is based on the belief that free-hand percussion with hammers of stone or other hard or heavy material was the exclusive or principal quarry shop process.

The process of manufacture and the steps of development were essentially as follows: Grasping a bowlder in either hand, the first movement was to strike the edge of one against that of the other at the proper angle to detach the flake. The second movement and the third were similar, and so on until the circuit was completed. If no false stroke was made and the stone had the right fractures, these few blows, occupying but as many seconds, gave as a result a typical turtleback—a bowlder with one side faceted by artificial flaking, the other side, save through accident, remaining smooth. If the removal of a single row of flakes were not sufficient, the work was continued until the one side was reduced to a proper degree of convexity, and the availability of the stone for further elaboration was made apparent. If the results thus far reached were satisfactory, the stone was turned in the hand, and by a second series of blows the remaining smooth side was flaked away, when the result was a two faced stone or double turtleback—the incipient blade. With perhaps a few additional strong strokes the rough stone began to assume the appearance of the final form. If at this stage, or if at any preceding stage, the stone developed defects or unmanageable features (such as too great thickness, crookedness, or humps that could not be removed), it was thrown away, and thus became a part of the refuse; and it would appear that all the entire specimens collected, since they were taken by us from the refuse, did develop some of these shortcomings. If, however, the form developed properly, the work was continued into the final stage, which consisted in going over both sides a second and perhaps a third time, securing, by the use of small hammers and by deft and careful blows upon the edges, a thin, symmetric blade.

It is important to observe that when the thin blade was realized, the work of the quarry shop (and the only work of the quarry shop so far as shaping was concerned) was ended. The process and the machinery had accomplished all that was asked of them and all they were capable of accomplishing. The neat, but withal rude, blades, and these only of the shaped products, were carried away. Further work, additional shaping—and such there was in most cases, no doubt—employed other processes and was carried out in other fields. Flakes and fragments suitable for elaboration into implements may have been selected for transportation, but no evidence of this is procurable. The course of procedure just described Mr. Holmes has investigated in the most careful manner, and by experiment has followed every step of the process, and has achieved almost every result. Mr. Holmes found that in reaching one final form many failures were left by the way, and that these failures duplicate, and in proper proportions, all the forms found on the quarry sites. Mr. Holmes was unfortunately prevented from carrying out these experiments as fully as desirable by permanently disabling his left arm in attempting to flake a bowlder of very large size.

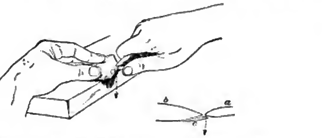
Mr. Holmes further found by these experiments—and the conclusion is a most important one—that every implement resembling the final form here described, and every blade-shaped projectile point made from a bowlder or similar bit of rock not already approximate in shape, must pass through the same or nearly the same stages of development, leaving the same wasters, whether shaped to-day, yesterday, or a million years ago; whether in the hands of the civilized, the barbarous or the savage man.

We are not prepared to say at just what point in the shaping of the blade or implement from quartzite and each of the other stones the percussion ceases and the pressure processes take up the work. It is certainly later in the quartzite than in any of the others because of its coarse grain and exceeding toughness and the consequent lack of thin and sharp edges on which the pressure tool must take hold.

In the method most readily available for the final steps a blank form or a flake having the approximate shape was held firmly between the fingers and thumb of the left hand. A firm piece of bone having a rather thin edge or angle like that of a three-cornered file was taken in the right hand and set upon the sharp edge of the stone and at right angles to it so firmly that a slight cut or notch was made in the bone; then, with a quick, firm movement of the right hand, met by a similar movement of the left, the bone was made to move across the edge of the stone, in doing which it took with it a flake, varying in length, width and depth with the skill and power of the workman, the nature of the stone, etc. A rapid repetition of this operation, accompanied by a proper resetting of the tool, quickly reduced the piece if it worked readily to almost any desired outline. The same result was obtained in various other ways, but always by means of suddenly applied or spasmodic pressure. The blank form may have been held down by the fingers on the edge of the stone, as shown in our engraving, and the point of the bone held in the other set so as to catch the edge of the stone to a width corresponding to that caught by the notched bone in the other position, when a quick downward pressure upon the flaking tool would remove the flake. Again, in larger work, where greater force was required to remove the flakes, a tool large enough to place against the arm or chest of the operator may have been used. In this way much additional force could be thrown into the spasmodic movement. Another device, practiced by some tribes, consisted of a notched or forked bone or pincers, which was set upon the sharp edge of the blank and given a sudden twist, thus removing the flake. These operations apply exclusively to implements of leaf blade type and to minute forms of other origin; the various ruder and heavier variety of tools were shaped by percussion exclusively.

The subjects of battered and abraded stone implements and incised or cut stone utensils are also treated in Mr. Holmes' interesting monograph.

Our engravings show the various steps in bowlder flaking and a series of flake forms showing progressive steps in the manufacture of projectile points from quartzite bowlders, and also a group in plaster, illustrating the work carried on in an aboriginal quarry workshop. This quarry group was prepared by Mr. Holmes as an exposition exhibit for the Columbian Exposition in Chicago, 1893. It is intended to exemplify a great art of the race—the shaping of stone by flaking processes. After the return of the group from the Exposition, Mr. Holmes conceived the notion that the figures could be taken to Piney Branch and placed in an actual quarry, thus more graphically portraying the ancient operations. A site was selected for the purpose on the margin of the gulch near Fourteenth Street, Washington, where some great oaks grow on the beds of ancient refuse. But before the project could be carried out, Mr. Holmes was called away from the work permanently. Messrs. Cushing and Dinwiddie, of the Bureau of Ethnology, generously took up the work, and the result is indicated in an interesting review which accompanies this monograph.



FLAKING BY PRESSURE, A BONE POINT BEING USED, THE IMPLEMENT TO BE SHAPED RESTING ON A SUPPORT.

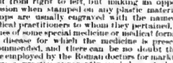
ROMAN MEDICINE STAMPS

IT is somewhat curious that medical specialism and proprietary medicines appear to have had their advent about the same period. That the latter owe their origin to the Roman specialists we have ample proof from the medicine stamps or stones which have been discovered from time to time on the sites of old Roman cities in France, Germany, etc., all of which agree in their general characters. These stones generally con-

IMPRESSION FROM A CIRCULAR ROMAN MEDICINE STAMP.

sist of small quadrilateral or oblong pieces of a greenish schist or steatite, engraved on one or more of their sides. The inscriptions are in small Roman capitals cut intagliate, and consequently reading on the stone itself from right to left, but making an opposite impression when stamped on any plastic material. The stamps are usually engraved with the names of the medical practitioners to whom they pertained, also the names of some special medicine or medical formula, and the disease for which the medicine is prescribed or recommended, and there can be no doubt that they were employed by the Roman doctors for marking their drugs, a practice apparently carried on at the various stations throughout Europe.

Most of the stamps discovered are inscribed with the



A PERFECT ROMAN MEDICINE STAMP.

names of medicines or preparations applicable for affections of the eye, and the diseases, when specified, are invariably of an ophthalmic nature. It is therefore probable that these stamps were used by oculists alone. The Romans employed the term collyria to both solid and liquid applications for the eye. The solid collyria were composed of various ingredients with a base of gum and starch, and wrought to a pasty consistence. They were used in almost every stage of disease of the eye. Some were known by the names of the oculists who invented them, others from their color, or from the

name of some great personage whom it may have cured. The stamps were employed to impress the soft substance with the required inscription, and also to stamp the labels (pittaria) attached to the vessels of the liquid collyria. Marcellus, in his work "De Medicamentis," specially praises the collyrium known under the name of "Evodes." He directs it to be dissolved and diluted in water, and introduced into the eyes with a probe.

The stamp of this collyrium has been discovered, and bears the following inscriptions: On one side, "The Evodes of Lucius Vallatinus for Cicatrices and Granulations;" on the other, "The Mild Crocodes of L. Vallatinus for Affections" (of the eyes).

From this it is evident that Vallatinus prepared more than one special application for the eyes.

A stamp found at Bath in 1731 bears the following interesting inscription:

"The Lenden Mellinum (or Golden Yellow Collyrium) of T. Junianus for clearness of vision," from which we may infer Junianus sold his "Golden Yellow Collyrium" to the colonists and natives of Bath some 1700 years ago. The popular name "Golden Ointment," given to an application for the eyes, is therefore of greater antiquity than is generally supposed, and it may interest pharmacists to know that it was originated by a Roman oculist.

Two other stamps discovered bear the following inscriptions:

"The Dialepidos or Copper Collyrium of Marcus Julius Satyrus for granulation of the eyelids."

"The Myrrh Collyrium of L. J. Ireuis to be used twice a day mixed with an egg at the commencement of ophthalmy."

Another stamp found at Kinchester in Herefordshire bears the following inscriptions on its sides:

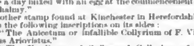
1. "The Anicetum or Infallible Collyrium of F. Vindacius Ariovistus."

2. "The Nardinum of Spikenard Collyrium of F. Vindacius Ariovistus."

3. "The Chloron or Green Collyrium of T. F. Vindax Ariovistus."

These are described by Dr. Simpson in the Monthly Medical Journal for 1851. A stamp discovered at Wroxeter in 1808 is inscribed as follows: "The Dialebanum of Tiberius Claudius, the physician, for all complaints of the eyes, to be used with egg." This stamp is now in the Shrewsbury Museum.

The most perfect stamp yet discovered (of which we give an illustration) was found at Tranent, near Edinburgh, and is now in the museum of the Society of Antiquaries of Scotland.



ROMAN OCULIST'S STAMP FOUND AT TRANENT, E. LOTHIAN, N. B.

The Roman practitioners seem to have pursued in regard to old cicatrices of the eye a treatment which is not followed by their successors in modern times, as they used various collyria for the purpose of dyeing or changing the color of these white cicatrices, and thus imparting to them some kind of tint that rendered the appearance of the eye, and the distinction between the transparent cornea and its cicatrices, less marked and striking. For this purpose galls appear to have been largely used.

It is worthy of note that Stolus, the first British medical practitioner mentioned in the pages of medical history, and whom Galen describes as celebris some 1700 years ago, originated the "Cinnabar Collyrium."

Altogether over sixty Roman oculist stamps have been discovered in different parts of Western Europe at various periods, which proves that medical specialism must have flourished in those early times.—Pharmaceutical Journal.

THE FINDING OF THE REMAINS OF THE FOSSIL SLOTH AT BIG BONE CAVE, TENNESSEE, IN 1896.*

The fossil sloth bones found in Big Bone Cave, Tennessee, illustrate an investigation at one of the points of contact between paleontology and archæology. They explain an effort made during the last several years by the Department of Archæology and Paleontology of the University of Pennsylvania to settle the question of man's antiquity in North America through a study of the association of human with animal remains in caves. Turning away, for a time, from mounds, village sites and buried cities, we have sought the help of the naturalist in a systematic attempt to penetrate the crust of recent earth under foot, to trace man through a mixture of the familiar vestiges of such animals as the deer, the bison, the bear, the beaver, the muskrat and the wolf, still existing in the American forest, and to follow him down into that older world layer next below called the Pleistocene. There we have endeavored to find, if possible, his bones still associated with the remains of the extinct mastodon, the mammoth, the tapir, the giant beaver and the fossil sloth.

Much remains to be done over a wide territory, before the evidence of American caves, for or against man's geological antiquity, can be adequately collected or reasonably summed up. But already, in the territory examined in the eastern United States and Central America, some landmarks seem to have been established in the pre-Columbian darkness.

Here, then, to return to the particular specimens presented by me, are bones which, from the point of view of anthropology, might be presumed to be very ancient, older than the pyramids of Egypt or the oldest inscribed brick yet found in Babylonia, but which, it must be confessed, appear quite modern. I removed them with my own hands out of the floor earth of Big Bone Cave, Van Buren County, Tenn., in last May (1896), while conducting thither an expedition for the Department of American and Prehistoric Archæology of the University of Pennsylvania.† Strange to say, many have articular cartilage clinging to them. Most have been gnawed by small rodents while still retaining their juices, and for these reasons and because, as we shall see later, they form part of a set of bones, doubtless of one and the same animal, obtained from Big Bone Cave first in 1885, next in 1884, and now last by me in 1896, they may be classed as pertaining to the most modern looking if not the most interesting series of remains of the extinct animal ever found in the United States. In this case, since the position and the association of the other specimens alluded to of 1885 and 1884, previously found in the same cave by farmers, were not observed, the bones here shown constitute the only remains of this Big Bone Cave animal, whose relation to surrounding facts bearing upon their age has been studied so as to furnish some reasonable conclusion as to how and when the creature got into the cave, and whether or not it was a contemporary of the Indian in the Southern mountains.

Fig. 1.—BIG BONE CAVE

In the first place, it should be said that the bones did not come from a human culture layer nor from a den of large carnivora. Neither were they found at a site where the cave explorer would have chosen to dig, but rather at a spot where all the conditions of exploration seemed unfavorable. They were rescued from one of the subterranean galleries at the last moment, after the whole cave had been rifled for saltpeter.

About one mile from the left bank of Caney Fork River, and one mile above the mouth of a confluent called Dry Branch, in Van Buren County, Tenn., probably 1,000 feet above the sea, Big Bone Cave opens from the carboniferous limestone upon the head of the "Beech Cove," one of the secluded ravines called "coves" that furrow the western slope of the Cumberland table land.

To our surprise, the point of interest in Big Bone Cave lay far beyond the reach of daylight. It was only found after turning to the right from the main tunnel and following a small bifurcating passage for 900 feet.

Laden with pickax and shovels, baskets, instruments, candles and provisions, now crouching where the roof lowered, now clambering upon a log across an intersecting crevice, eight or nine feet deep, we followed the lead of Priest, until directly on the footway a spot was reached where, in the utter darkness, beyond the range of the continued haltings of men, and probably of large animals, at a point where no human culture layer, under ordinary circumstances, could have been formed, these remarkable bones of the sloth and all other sloth bones, known to have been previously removed from the cave, were found. Elsewhere the evidence of the relation of animals and men to the cavern, whatever its character, had been destroyed.

Fig. 2.—CLAW WITH CARTILAGE AND HORNY SHEATH OF THE SLOTH MEGALONYX.

From the J. P. Wetherill collection at the Academy of Natural Sciences of Philadelphia. One of the bones found in Big Bone Cave before 1896, and unquestionably a part of the same young animal represented by the other illustrations. Actual size.

The record of these bones is, therefore, very different from that of animal remains dug out of the rock shelters of Europe, or from that of specimens derived from any layer of caked human rubbish where savages have been wont to take subterranean refuge. Men certainly did not bring them into the cave. Frost had never reached them. Neither would change of temperature have affected them where they appeared to have rested in the dry earth in an unchangeably cool air since the time of their deposition.

Let us describe this place. The roof has expanded over several branching alcoves, partitioned head high by screens of eroded rock. Mysterious crevices in the ceiling rise above us beyond the reach of candle light. There are no stalactites and we feel no trace of dampness. The severe outside heat of the Southern spring has been reduced to a dry and cool subterranean temperature of 55° F. Where a flanking screen narrows the gallery to a width of three and four feet, the earth is soft and mealy under foot and covers the whole floor, rising in a cloud of dust when disturbed by a kick. This floor deposit proves on examination to consist of a noxious and volatile mantle of dry, loose excrements, mixed with vegetable remains, covering up and spoiling by its intermixture the nitrous earth resting in lumps beneath it, and thus sufficiently explaining why, as far as saltpeter digging was concerned, that part of the cave had never been disturbed.

We were directly upon the cave path, where back and forth over the dusty manure all footsteps of all saltpeter hunters, all white men, all Indians, choosing to penetrate deeper into the cave, must needs have passed. Their trampling had draggled the surface, kicking earth into it from other areas, or dropping "peter dirt" upon it from bags. Moreover, charred pieces of resinous pine, Pinus mitis, twigs of hazel, Corylus americana, and fragments of burnt cane, Arundinaria tecta, strewed the surface, representing doubtless the remains of the torches of such white niter hunters as had not had lamps or candles, and, we may reasonably suppose, of the Indians who had preceded them. The appearance of this surface film, then, which I have called

LAYER 1

(Two to three inches thick),

thus disturbed for two or three inches, and scattered with lumps of nitrous earth and with these burnt sticks, was sufficient to demonstrate that human beings had visited the cave, if no further proof of the fact had existed. Over and above the certainty that white men had long passed and repassed the spot, and that many of the torch ends, and particularly the pieces of pitch pine which suggested the splitting agency of iron tools, might be referred to them, it seemed reasonable to suppose that some at least of the pieces of charred cane resembling fragments of Arundinaria found by us mingled with aboriginal bones in the sepulchral chasm

* Abstract of paper by Henry C. Mercer, curator of the Museum of American and Prehistoric Archæology at the University of Pennsylvania, read before the American Philosophical Society.

† I take pleasure in returning the thanks of the department and of myself to our vice president, Dr. William Pepper, who alone defrayed the expenses of this expedition.

at Lookout Cave) had been cast away at the spot by Indians.

Our party of four, Mr. G. B. Johnson, James Priest, my assistant, Joseph Musselman, and myself, had stopped, and Priest, our guide, holding down his candle, pointed to a hollow caused by digging in the mass of dry manure, where he, about 1884, while filling several bags full of the "fertilizer," as he called it, for his garden, and later Mr. Johnson himself, on a similar errand, had found several vertebræ, ribs, the pelvis and the skull with teeth of a large animal (the extinct sloth), which, after remaining for some time at the house of Mr. Johnson, had been sent to Nashville and sold. For this reason, and as well testified by the letters to me of Prof. J. M. Safford, State geologist of Tennessee, who first advised my exploring the cave, let it be said in parenthesis that without doubt the sloth skull now in the possession of Prof. Safford, at Nashville, and which I have been unfortunately unable to obtain from him for comparative study, is the skull thus found by Priest, and because this skull and the other bones belonging to Prof. Safford, corresponding to those described as found by Priest and Johnson at this place, also show cartilage, and further because the evidence indicates that there was only one sloth at this point, with no reason shown why there should have been more than one, and because it appeared that no other spot adapted for the discovery of fossil bones had existed at the entrance of the cave, for these reasons, I believe that the Nashville bones and my set go together as parts of one animal; and further, as first suggested by Prof. Safford and now shown by my examination, let me add that still another and a third set of sloth bones, belonging to the Academy of Natural Sciences, of Philadelphia, herewith shown (see Fig. 2 for one of them), found by a farmer in the cave and described by Dr. Harlan in 1835, also showing cartilage equally fresh in appearance and referable to a young animal (because of the loose epiphyses) may well be believed to constitute skeletal portions of the same individual.

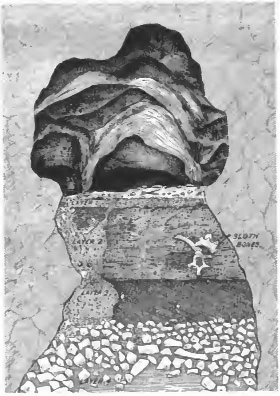


FIG. 3.

Diagram showing a vertical section of the gallery in Big Bone Cave where the sloth bones were found. Layer 1 (2½ inches), disturbed surface rubbish with charcoal torch ends. Layer 2 (2 to 2½ feet), dry loose rat excrement, animal and vegetable remains, etc., with sloth bones. Layer 3 (1 foot), crusted lower portion of rat excrement and vegetable remains formed before the advent of the sloth bones. Layer 4 (of undetermined depth), loose pieces of nitrous clay, dry and hard, mixed with manure. The disturbance resulting in the intrusion of torch ends and other objects into the deposit as far as Layer 4, caused by burrowing rats, is seen against the left cave wall.

These subsequently arrived at conclusions, however, did not concern us when, first pausing in the candle light, we placed our tools and baskets upon the ground to listen to the account of Priest. Our hope of finding more bones depended upon the chance that he had not dug up the whole floor and that other remains, resting beyond the limit of his digging, had escaped him and remained to reward our search.

Down through the manure and nitrous earth resting beneath it, from nine in the morning till five in the afternoon, beginning where the consistency of the deposit showed that Priest and other diggers had left off, we worked in the dim candle light, until our hunting had accomplished its object, and until the walls of our trench revealed the facts herewith described, and first that of a sequence in time marked by the layers that had accumulated upon the foothold, and of which two epoch-denoting divisions confronted us. They consisted of (below and older) a water-deposited nitrous clay, resting upon the bottom rock, standing for a time when the cave was wet, and (above and later) the manure previously referred to, testifying to an epoch when the cave was dry, and to the latter division with its subdivisions described as Layers 1, 2 and 3, and hence to the later time belong the sloth bones here shown. One after another they were found in the dry manure, which, lying invariably under Layer 1 above described, I have called

LAYER 2

(Two to two and a half feet thick. See Fig. 3.)

As we worked forward through this layer with shovel, hands and trowel to where it thinned out and the saltpeter earth now removed had formed the foothold beyond it, we found it to consist almost entirely of well preserved, dry excrements of the cave rat, Neotoma magister, which intermixed in lesser quantity with coprolites of porcupines, Erethizon dorsatus, formed the conspicuous ingredients of the mass. In consistency like a bin of oats, the deposit answered every disturbance with a cloud of pungent dust. Nuts, sticks, fur and moss were easily seen in it by candle light, but more minute search in the cave and a subsequent study of the specimens preserved revealed at various points the seeds, grass, bark, leaves, hair and small botanical fragments described later. In the midst of this interesting rubbish, often in contact with seeds, nuts and hair, appeared the twelve sloth bones found, protruding from the vertical side of the trench at depths of from eight to fourteen inches.

The first bone found (see Fig. 4) was an epiphysis of a humerus. Then came a well preserved vertebra No. 2 (see Fig. 5), found at a depth of one foot eight inches below the surface and one foot from the right wall of the cave. The small coprolites touched it on all sides. Just above it lay a small twig of wood, and close to it several bones of bats, described later, while both above and below it we noticed wads of fine hair. The deposit was exceedingly dry, and its removal filled the cave with suffocating dust clouds. Immediately in contact with bone No. 2, as we worked horizontally into the bank, lay bones Nos. 3, 3½ and 4, two unseparated vertebræ with a loose epiphysis resting between them, directly under which we found two gnawed hickory nuts and an acorn.

FIG. 4.

First bone found (in Layer 2, depth about 10 inches), epiphysis or unknitted end of the humerus of a young sloth, Megalonyx. Photographed, resting upon the characteristic rubbish of Layer 2 found around it. 1. Bat's jaw, Adelonycteris fusca. 2. Hickory nut and fragment gnawed by rodent, Hicoria glabra. 3. Excrement of large mammal, possibly sloth. 4. Felted hair of bats, rats, and porcupines mixed with a woolly fur, possibly belonging to the sloth itself. 5. Bones of the bat, Adelonycteris fusca. The background is composed of a mass of dry coprolites of cave rats, brown dusty earth, and fragments of hard cave clay, "petet dirt."

FIG. 5.

The second bone found (in Layer 2, depth 1 foot 8 inches). Dorsal vertebra.

As we advanced vertically into the manure, another vertebra, the fifth bone found, bone No. 6, the heel bone (calcaneum), and bone No. 7 (the astragalus), were revealed lying but a few inches apart. With deep interest I removed them. Just below the fifth bone, at which point the deposit had hardened considerably (Layer 3) and was mixed with fine pieces of saltpeter earth, another acorn was found, and still another under the astragalus.

On that day, May 6, 1896, at 3:15 in the afternoon, with the wind blowing from the north, a slight draught of air wafted the currents of dust inward as we worked, while, to testify to the open communication of that part of the gallery and the outer world by means of the roof holes, a small cricket appeared, crawling upon the disturbed earth as we worked at the third bone.

A considerably gnawed rib fragment (see Fig. 7) was followed by a loose epiphysis, and a final vertebra, the tenth bone found, lay against the rock wall on the right, not much more than eight inches below the surface, where, close to the top of the deposit and still against the wall, the wads of hair were best preserved. Here also were found a gnawed butternut, several pieces of grass, several small bat bones and dung as usual. The position of these latter objects close to the wall caused us to suspect that they had slid down from the surface, just as close to the left side twigs of leaves had probably been intruded in the rat holes. But the objects found at or below the position of the other bones we regarded as of equal age with them, and as truly indicative of the nature of the layer.

Our observation of the position of all the bones showed that they were not (with the exception of the two vertebræ and epiphyses) to skeletal order; several epiphyses were loose; the calcaneum (heel bone) lay close to the vertebræ; the single rib found was broken and turned. Unquestionably the bones had been

drugged and twisted out of place (inferentially by the gnawing rats or the porcupines) since their deposition. Some may have been carried away to hidden crannies through burrows noted later communicating with the rubbish.

(To be continued.)

THE FORESTS OF ALASKA.

THE great maritime forest of northwestern North America, which at the south embraces the redwoods of California and spreads over western Oregon and Washington, terminates on the Alaskan coast on the eastern shores of Kadiak Island, just below the fifty-eighth degree of north latitude. Taken as a whole, this coniferous forest is unequaled in productiveness and in the size, beauty and value of its trees. Not only is the redwood the largest of all conifers, with the single exception of its relative of the Sierras, which excels it in bulk of stem and branches, but not in height, but in this maritime forest are found the largest spruce tree and the largest hemlock in the whole world. Of the arbor-vitaes here grows the giant of its race; and of all the cypress tribe none can equal Lawson's cypress in majesty of port. Here, too, the alder becomes a great tree, and firs assume their noblest proportions.

To-day, however, we would speak more particularly of that part of this forest covering the coast mountains of southeastern Alaska, and which in many of its general features resembles the forests of Puget Sound and of western British Columbia, although the Douglas spruce, the most abundant tree on the shores of Puget Sound and Vancouver Island, where it surpasses all its associates in height and in size of stem, does not reach Alaska. The white fir (Abies grandis), which is so conspicuous with its tall pyramids of lustrous dark green foliage on the shores of the Gulf of Georgia, is absent, too, from the Alaska forest, as is the great-leaved maple (Acer macrophyllum), abundant in all the coast region further south. The arbor-vitæ (Thuya gigantea), which is common and of fine size on Prince of Wales Island and on the southern part of the Cleveland Peninsula, is rare, if it exists at all, north of latitude fifty-six; and the coast forest of southeastern Alaska is composed almost entirely of two trees, the Sitka spruce (Picea Sitchensis) and Merten's hemlock (Tsuga Mertensiana). From the edge of tidewater these two trees grow up to the timber line, which varies in elevation from 2,500 to 4,000 feet, everywhere in dense, serried masses, like the blades of grass in a meadow, covering all islands and the seaward slopes of the mainland mountains, which shut off the moisture from the dry interior. Sometimes the spruces predominate, especially toward the north; sometimes the hemlocks are more abundant, and often the two are mixed in nearly equal numbers. Through this forest the Sitka cypress (Cupressus Nootkatensis) is scattered, usually at elevations of about 1,000 feet above the sea level, although it often descends to the water's edge. It grows, not in large bodies, but often in numbers sufficient to enliven the somber spruces and hemlocks with the cheerful yellow tints of the graceful frond-like branchlets which descend from the wide-spreading branches of this splendid tree, unrivaled by any other American conifer in the beauty and value of its wood. On the margins of the little flats and beaches which occur only at the mouths of streams—for on the Alaska coast the mountains usually rise abruptly from the sea—alders of two kinds and the lovely Sitka willow light the borders of the forest; and alders sometimes extend up the banks of streams or hang over rocky sea cliffs. On sloping seashore bogs, rich in mosses and studded with many charming herbs and dwarf shrubs, Pinus contorta, the only Alaskan pine, occurs rather sparingly; and on Baranof Island, near the town of Sitka, Patton's spruce (Tsuga Pattoni), which is probably widely distributed over the coast mountains at high altitudes, descends with a few small individuals nearly to the sea level. These, with the addition of the balsam poplar, which is only seen near streams, and the little Rocky Mountain maple (Acer glabrum) are the only trees of the coast forest of southeastern Alaska, which is remarkable in its poverty of species, in its richness in individuals and in the size these attain in the thin soil, a few inches deep at best, and often on the nearly perpendicular slopes of these glacier-swept hills. They are wonderful, too, in the deep mosses of the forest floor, and in their impenetrable undergrowth of blue berries of many varieties, salmon berries, menziesias, and the terrible devil's club (Panax horrida), which so cover the ground with their entangled stems that travel through the woods is practically impossible.

As compared with trees in forests further south, those of Alaska are not large, although spruces and hemlocks a hundred and fifty feet high, with trunks three or four feet in diameter, are not rare at the sea level as far north as Baranof Island; ascending from the shore, however, the trees rapidly decrease in size and near the timber line become small and stunted, as they often do at the sea level at the heads of the numerous estuaries and fiords cut deeply into the mainland coast range.

The deepest and most interesting of these fiords, the Lynn Canal, a narrow continuation of Chatham Strait, extends a hundred miles northward from the coast nearly to the sixtieth degree, and at its head is fed by the waters of the Chilkat, the Chilkoot and the Skagway rivers, swift mountain streams, which afford difficult passage across low passes into the interior to the headwaters of the great western tributary of the Yukon. The forests at the head of the Lynn Canal differ somewhat from those in the region nearer the coast. The narrow bottom lands are covered with masses of balsam poplar or with the so-called green alder, which here becomes a tree fifty feet high. The spruce is still abundant at the river level and on the lower slopes, but it is everywhere small and stunted. The hemlock also occurs here, but only sparingly, and not of large size. The pine is seen on the flats and at considerable elevation on the hillsides, but here its leaves are broader than those of the coast trees, and it is passing into the variety Murrayana of the interior plateau, the Lodge pole pine of our northern Rocky Mountains. A white birch is very common at low elevations, and is more like the birches of Siberia and northern Japan than any described American species, and growing with it is Acer glabrum, which is certainly the most widely distributed of all the North American maples, and probably the most boreal member of the genus, and Patton's spruce is at the timber line.

When these passes from the humid coast region to the dry interior are crossed, an entirely different forest is encountered. The hemlock and the Sitka spruce have disappeared, and the largest tree in the open scattered groves near the shores of Lake Bennett and Lake Linderman is a fir (Abies lasiocarpa). With it grow stunted white spruces (Picea alba), which in greater or lesser abundance and mingled with balsam poplars, birches and alders are scattered over the basins of the Yukon and its tributaries for hundreds of miles, and finally reach the Pacific coast on Kotzebue Sound within the Arctic Circle, and nearly five degrees north of Kadiak Island, where the forests of southeastern Alaska give way to a growth of grasses and low alders and willows.

Trees cannot be cut lawfully in Alaska for timber or fuel, for there is no law which permits the sales of stumpage or timber lands, and no law relating in any way to the forest but the one which forbids all shipment of wood from the Territory. There are a few sawmills in Alaska, however, and the number will soon be increased, and a large quantity of fire wood is consumed at the salmon canneries and quartz mines, but the government gets nothing for it, and is powerless to prevent damage to the public domain. Fortunately, the climate of southeastern Alaska is so humid that forest fires are rare, and never very destructive, and reproduction is sure and rapid. These forests, therefore, even with American methods, will not soon or easily be destroyed; and here and to the southward along the coast ranges and islands of British Columbia through nine degrees of latitude from Cross Sound, at the north of Chicagof Island, to the Straits of Fuca, is now the greatest continuous body of coniferous timber in the world, almost unmarked as yet by the ax, safe from fire and of easy access, from which the world will be able to draw great stores of material when the redwoods and Douglas spruces of the South have fallen, and our south Atlantic and Gulf shore pineries are only dim memories.—Garden and Forest.

THE MINISTRY OF LEAVES.

IN the body of an animal there is always going on a process of slow combustion; oxygen taken in by the lungs enters into union with carbon derived from the food, carbonic acid is formed, and heat evolved. Every atom of carbon disengaged from oxygen by the plant represents an expenditure of heat upon the leaves equal to that developed during its combination with oxygen in the animal system. In the leaves this heat disappears; it becomes latent, and is stored up as potential energy. When we burn a piece of wood, not only is the carbon which the tree originally extracted from the air restored to the atmosphere in the form of carbonic acid, but the heat given out by the burning wood corresponds exactly to the amount by which the sunbeams were chilled through the activity of the leaves while the wood was growing. Robbing the sunshine of its heat in this way, leaves must act as refrigerators. Leaves exert a further cooling influence on account of the watery vapor they are constantly giving off, for whenever water evaporates, much heat is rendered latent and ceases to be discerned by the senses. A man is said to exhale about one hundred gallons of carbonic acid in a day. Boussingault estimated that a square yard of leaf surface, reckoning both the upper and lower sides of the leaves, can, under favorable circumstances, decompose rather more than a gallon of carbonic acid in a day. At this rate, one hundred square yards of leaf surface should keep a man going with oxygen. A single tree would suffice for quite a number of people, for, according to the late Prof. Asa Gray's computation, even a moderately sized elm possesses five acres of leaf surface.

Widely as they differ in appearance, a lung and a leaf are constructed on very similar principles. In the lungs the air tubes are subdivided into an infinite number of small ramifications, around which the blood vessels are distributed in an extremely fine network. By this arrangement an immense surface is exposed to the air, with comparatively small expenditure of space. Through the delicate membranous walls of these fine tubes the air penetrates into the blood vessels beneath, and from the blood carbonic acid diffuses into the air tubes, and is exhaled. The typical leaf, again, is a thin expanded plate, offering a large surface to the air relatively to its mass; its lower stratum is honeycombed with innumerable air spaces and intercellular passages, which communicate with the external air through thousands of pores or stomata. Oxygen and carbonic acid are exchanged through the walls of the leaf cells very much as in the lungs, but in the reverse order. The flattened form of the leaf secures illumination and promotes evaporation; lungs, having no need of light, are shaped to suit the space available. The resemblance between the submerged leaves of aquatic plants, such as the water buttercup, and the external gills or branchiæ of the young tadpole and other amphibians, is particularly striking. Both organs are cut up into fine, threadlike segments, giving them a fringed or featherlike appearance. The large absorbing area thus presented to the water facilitates the absorption of the dissolved gases. Leaves are, however, organs of nutrition. This resemblance to respiratory organs arises entirely from the fact that by far the largest proportion of a plant's food is absorbed in the gaseous condition. Referring to this adaptation of the leaf, Johnstone, in his "Agricultural Chemistry," says: "How beautiful is the contrivance of the expanded leaf! The air contains one gallon of carbonic acid in two thousand five hundred, and this proportion has been adjusted to the health and comfort of animals, to whom this gas is hurtful. But to catch this minute quantity, the tree hangs out thousands of square feet of leaf in perpetual motion, through an ever-moving air; and thus by the conjoined labors of millions of pores, the substance of whole forests of solid wood is slowly extracted from the fleeting winds."

Chlorophyl itself owes its formation to light; but to conceive how the ethereal undulations, acting on the living substance of a leaf cell, can elaborate a structure so complex, baffles imagination. How marvelous are the properties of light and how manifold its adjustments to differently constituted materials! Light is at once the most useful of natural agencies and the most beautiful of physical phenomena. And yet it must be tempered to our vision. Painful and blinding the glare from rock or desert, but what more grateful than the sight of fresh green meadows! In contact with the grass light is purified from rays which fatigue and injure our eyes. This tempering of the sunshine is another of the many benefactions we owe to the ministry of leaves.—Alex. S. Wilson, in Knowledge.

HOT SODA WATER DRINKS.

HOT soda is served by drawing 1 or 1½ ounces of the flavoring preparation, sirup, extract, juice, etc., into the mug, adding cream and sugar, if these be required, filling the cup with hot water, and serving with a spoon. The amount of flavoring stated is intended for an 8 ounce mug. Sometimes the beverage is topped off with whipped cream or with a spice. Here are some formulas:

Chocolate.

Baker's fountain chocolate ......1 pound.
Sirup .... 1 gallon.
Extract vanilla, enough.

Shave the chocolate into a gallon porcelained evaporating dish and melt with a gentle heat, stirring with a thin bladed spatula. When melted remove from the fire and add one ounce of cold water, mixing well. Add gradually one gallon of hot sirup and strain; flavor to suit. Use one ounce to a mug.

Hot Egg Chocolate.

Break a fresh egg into a soda tumbler; add 1½ ounces chocolate sirup and 1 ounce cream; shake thoroughly, add hot soda slowly into the shaker, stirring meanwhile; strain carefully into mug, top off with whipped cream and serve.

Hot Chocolate and Milk.

Chocolate sirup ....1 ounce.
Hot milk.............................4 "

Stir well, fill mug with hot soda and serve.

Coffee.

(1) Coffee sirup may be made by adding boiling water from the apparatus to 1 pound of coffee, placed in a suitable filter or coffee pot, until 2 quarts of the infusion are obtained. Add to this 3 pounds of sugar. In dispensing, first put sufficient cream in the cup, add the coffee, then sweeten, if necessary, and mix with the stream from the draught tube.

(2) Mocha coffee (ground fine) ...... 4 ounces.
Java coffee (ground fine) ...... 4 "
Granulated sugar.............. 6 pounds.
Hot water .... q. s.

Percolate the coffee with hot water until the percolate measures 72 ounces. Dissolve the sugar in the percolate by agitation without heat and strain.

Lemon.

Lemon sirup is, of course, best prepared when the juice of the fruit is squeezed into the glass, powdered sugar and hot water added, and the whole shaken well in a shaker. When this is not possible, lemon juice previously prepared is the best substitute. Try the following formula:

Lemon juice ....1 ounce.
Hot soda sirup .... 4 "

Mix with stream from draught tube.

Ginger.

Fluid extract of ginger.......... 2½ ounces.
Sugar.................................40 "
Water, to .... 2¼ pints.

Take 10 ounces of the sugar and mix with the fluid extract of ginger; heat on the water bath until the alcohol is evaporated. Then mix with 20 ounces of water and shake till dissolved. Filter and add the balance of the water and the sugar. Dissolve by agitation.

Hot Egg Coffee.

Break a fresh egg into a soda tumbler; add 1 ounce coffee sirup; shake thoroughly, add hot milk slowly into the shaker, strain carefully into mug, top off with whipped cream and serve.

Cocoa Sirup.

Cocoa, light, soluble. .... 4 ounces.
Granulated sugar....................2 pounds.
Boiling hot water ....1 quart.
Extract vanilla.........................1 ounce.

Dissolve the cocoa in the hot water, by stirring, then add the sugar and dissolve. Strain, and when cold add the vanilla extract. To dispense,

Cocoa.

Cocoa sirup........................... 2 ounces.
Cream.................................. 1 "

Turn on the hot water stream and stir while filling. Top off with whipped cream.

Hot Soda Toddy.

Lemon juice ....2 fl. drachms.
Lemon sirup................................1 fl. ounce.
Aromatic bitters...........................1 fl. drachm.
Hot water, enough to fill an 8 ounce mug.

Sprinkle with nutmeg or cinnamon.

Hot Orange Phosphate.

Orange sirup .... 1 fl. ounce.
Solution of acid phosphate ...... 1 fl. drachm.
Hot water, enough to fill an 8 ounce mug.

It is prepared more acceptably by mixing the juice of half an orange with acid phosphate, sugar and hot water.—Pharmaceutical Era.

A French inventor has made use of a rubber tube as a core on which to mould pipes of cement and sand. To make a continuous conduit in the ground, a trench is dug, and at the bottom of this is placed a layer of cement mortar. On this rests the rubber tube, which is surrounded by canvas, and inflated. The remainder of the trench is then filled with cement mortar, and as soon as this is set the rubber core can be deflated and removed for use elsewhere. It is stated that 6 in. pipes have been made on this plan out of hydraulic lime and sand, at a cost of about 22 cents per yard.

ENGINEERING NOTES.

The Railroad Gazette estimates that to put the railway rolling stock of the United States on a normal basis of efficiency, orders this year will have to be given to the shops and factories for 2,342 locomotives, 97,246 freight cars and 5,400 passenger cars. During the past nine months of the current year locomotives to the number of 771 have been ordered, freight cars 27,700, and 179 passenger cars. Only 77 railway companies have ordered new engines, and the freight car orders have been placed by about the same number of companies. About one-third the number of locomotives have been ordered that should be built to thoroughly equip the roads. The freight cars which have been ordered are less than one-third the number which estimates designate as the requirement necessary to bring equipment up to a proper standard. Orders are about one-third the number built in 1890. The Lumberman adds that "thus it can be seen that the prospects for work in the car factories for the remainder of the year are good. The activity already developed is not likely to flag for months, but, rather, is likely to increase."

Some interesting experiments to ascertain the influence of cold upon the bending properties of wrought iron, Siemens Martin open-hearth steel, Thomas steel, spring and cast steel, have been made by Prof. M. Rudeloff, director of the imperial German testing station, says The Engineer. The samples were rounded off on the edges; the tests were made in a press. Cooling down to −20° C. exercised but little influence upon the flexibility of the different materials tested. Only in the case of spring steel and forged iron a reduction of the bending angle was observed, from 91° to 84° with the former and from 159° to 139° with the latter, while the other samples could be bent together at −20° C. as well as at ordinary room temperature, so that the two shanks covered each other, equaling a bending angle of 180°. The flexibility was in some cases at −20° C. even higher than at ordinary temperature, only in the case of Siemens-Martin and Thomas steel it declined from 100 to 80. The samples showed at the bending place no change in the material that might have been caused by the cooling down to −20° C. A cooling to −80° C. had likewise very little influence upon the flexibility of soft rivet iron and rolled puddled iron, but the flexibility of the other materials suffered by the lower temperature, especially cast and spring steel.

The degree of accuracy attainable in modern naval gunnery in actual warfare is something yet to be determined. With the exception of the battle of the Yalu during the Chino-Japanese war, there had been no opportunity for finding out what might be accomplished at long range by a modern gun, mounted on so unstable a platform as the deck of a rolling vessel; and the value of the Yalu fight as an object lesson in this respect was impaired by the relatively unskilled character of the gunners, says Cassier's Magazine. Certain it is that while death and destruction were meted out all around in that encounter, an enormous amount of ammunition was used up in the work. The bombardment of Alexandria by the British fleet in the early eighties afforded none of the conditions of a sea fight, since the vessels were at anchor in practically smooth water and their target was certainly immovable enough; and even there the expenditure of powder and shell was out of all proportion to the damage inflicted. The point has recently been made, however, that, after all, it is astonishing that a ship is ever struck by a projectile from a gun, and that there is probably more luck than cunning in the art of modern naval warfare. In a lecture at the United States Naval War College at Newport, Prof. Alger, a short time ago, stated, for example, that at a convenient fighting distance, say two thousand yards, a modern battleship, like the Indiana of the United States navy, appears to be of the same size as a picture of her, eight-tenths of an inch long, held at the point of clear vision, about 14 in. from the eye, while the outlines of the real ship will be much less clear and distinct than those of the picture. The height would, of course, appear to be still less, so that the difficulty of hitting such a target, even with the ship at rest and the gun in a fort, instead of both moving more or less rapidly, can be appreciated at least to some extent. The element of luck truly must enter largely into effective fire under such conditions.

Capt. G. A. Chaddock, F.R.G.S., a Liverpool navigator of thirty years' experience in both steam and sailing craft, has invented an appliance which ought to be of immense value to shipowners and their crews all the world over in saving both life and property. The present wooden hatches, laid on from above, are easily forced up by the inrush of water consequent upon a hole being knocked in the bottom of a vessel, the results being that she rapidly tips and sinks. The telescopic iron hatches, which constitute Capt. Chaddock's invention, are so arranged that the pressure of water from below would, in such a contingency, bind them more tightly in their places, precluding the possibility of the water rising above the first deck, which forms a platform or horizontal bulkhead, preventing the ship from sinking and water from reaching the cargo from above. The improvements give more effective ventilation to prevent cargo heating and sweating, and are also capable of being hermetically sealed, so as to neutralize fire, and, generally speaking, watertight compartments are doubled, the consequent seaworthiness of a vessel being vastly increased. Besides these essential advantages there are many others, as, for instance, more speedy manipulation and no risk of injury by careless handling. Bad smells from cargo do not reach the passengers. The vessel would be a salvage appliance in herself in case of stranding, and last, but not least, the hatches are particularly suitable for deep water ballast tanks. The practical effect of Capt. Chaddock's improved hatches will be to multiply the watertight divisions of a ship in proportion as the number of decks are to bulkheads. Thus a ship with eight bulkheads and three decks would at present have only nine watertight compartments with wooden hatches, but with the improved hatches and watertight decks the same ship would have twenty-five compartments, an increase of sixteen extra compartments. Capt. Chaddock's improvements have been submitted to the leading shipowners, underwriters, marine engineers, and other practical men, both in Europe and the United States, and they have spoken of them in the highest terms.

MISCELLANEOUS NOTES.

That galvanized sheets which are made of steel with the oxide formed in rolling removed, and then coated with spelter, are not more generally used in boiler or tank works is because the advantages they possess are not fully understood, says The Iron and Coal Trades Review. It is, however, well for boiler makers to remember that the action of moisture, especially when impregnated with sulphur arising from soft coal, has a destructive influence on steel plates, rusting them rapidly, particularly in the lighter gages. This may be delayed by frequent painting or varnishing. A coating of spelter makes steel sheets impervious to moisture, and therefore the life of the metal is preserved almost indefinitely, especially where it may be painted with the ordinary preservatives from time to time.

The ventilation of the Metropolitan Railway, of London, has at various times given rise to a considerable amount of well grounded complaint. It is, however, a matter which, in some respects, has been the cause of needless alarm. Needless because, although the ventilation on some parts of the line is unquestionably bad, yet it has been proved that the atmosphere does not contain elements of positive danger. At the best, however, this atmosphere is, as regards personal comfort, most objectionable, although it is not so inimical to health as is generally supposed. This is evidenced by the healthy condition of those employes of the company who are obliged to spend a considerable portion of their time on the underground line. That this atmosphere does affect some persons is not to be denied, but that it is not absolutely dangerous to health is shown by the fact that one of the Metropolitan Company's servants has worked for twenty years on the line at Gower Street without detriment to his health, while another, who has spent twenty-five years in a similarly circumstanced station, is as healthy as can be desired.

Owing to transport difficulties, and also to the sluggishness and poverty of the rural population of certain districts of the Austrian empire, some peculiar methods of trading in salt have survived in Galicia, for instance, says the Trade Journals Review. For the purpose of easy transport, and in order to facilitate the retail trade, the salt is supplied in the compressed state, and the government salines of Ischl are now introducing a briquette press, invented by Philip Mayer, which turns out 1,000 bricks of salt of 0·6 kg. (1·3 lb.) each per hour. The moulds are mounted in three or four groups of six or more on a revolving table. Around this table are arranged the appliances for weighing, for filling and emptying the moulds, and the press. The apparatus requires three attendants. One man takes charge of the weighing; the second makes the brick by manipulating two levers; the third removes the finished brick. With the first machine of this kind, each operation took 17 seconds, that is to say, one set of salt cakes was delivered after that period. But larger machines have already been ordered by the Netherlands, for their East Indian colonies. In these machines up to 16 moulds are united in one group, so that 16 bricks are delivered simultaneously. Each brick is subdivided and can easily be broken into four parts, and weight and price are stamped into each brick.

As the question of good joints for conduit pipes is one of considerable interest, the Nouvelles Annales de Construction draws attention to the device, first adopted about five years ago at Elberfeld in the Wupper valley, by the well known hydraulic engineer of Frankfort-on-the-Main, J. Lindley. At Elberfeld the conduits lie in an exceedingly permeable soil. The joints have answered perfectly, and they are made easily and rapidly; the materials are, perhaps, a little expensive. The joint in question has been used with pipes widening out at one extremity in the usual fashion. The two pipes are placed in position, a tarred cord is pressed into the recess, and a little clay funnel is made on the outside, through which the mixture is poured into the ring-shaped recess between the two pipe ends, which is closed by a flat rubber washer, well greased on the one side, and held in position by a steel collar. The mixture consists of two parts, by weight, of tar and one of asphalt. It hardens within less than a minute, when the rubber washer and the clay are removed. The joint is now perfect, and the canal need no longer be kept dry, so that the operations are much more expeditious than with cement. As regards expense, a pipe a foot in diameter would require about 4 lb. of mixture, ½ lb. of cord, and the operation would cost a little less than sixpence. A much more exhaustive article on pipe joints, from which the Nouvelles Annales possibly drew their information, is published in the Gesundheits Ingenieur by Unna.

The following methods are recommended for the detection of artificial silk. Mr. P. Truchot, in the Annales de Chimie Analytique, says that in burning no acid vapors are evolved, nor is the odor of burned horn noticeable. Schweitzer's reagent largely swells both kinds of silk before they pass over into solution; an addition of water or hydrochloric acid precipitates the artificial silk as a white, flaky cellulose. When dissolved in pure sulphuric acid (66° Bé.) artificial silk forms a deep yellow sirupy fluid, which is colored dark blue by the addition of a solution of diphenilamine sulphate. The presence of artificial silk may also be detected direct, without solution, by dipping a small clipping of the fabric to be examined into a solution of diphenilamine sulphate, whereby every thread of the artificial silk is tinged dark blue, while natural silk remains entirely unaffected. Without resorting to chemical methods, a very simple way of recognizing artificial silk is given in the Dry Goods Chronicle, and one which ought to be invaluable to buyers of dress goods. A wood pulp silk is now used to a large extent in foreign made fancy goods to give a brighter effect than can be imparted to the fabric by the use of natural silk. The test is to unravel the threads of the fabric and put the silk strands into the mouth and masticate it vigorously. Artificial silk readily dissolves under this operation and breaks into minute particles, and when pulled between the fingers shows no thread, but a mass of cellulose or pulp. Natural silk, no matter how thoroughly it is masticated, will retain its fibrous strength. The artificial silk offers no resistance to the teeth, which readily go through it, whereas natural silk does. It is sufficient to moisten the thread on the tongue and then submit it to a pull between the fingers. Natural silk will resist a strong pull, wet or dry.

SELECTED FORMULÆ.

Picture Transferrer.—A very weak solution of soft soap and pearlashes is used to transfer recent prints, such as illustrations from papers, etc., to unglazed paper. Such a solution as—

Soft soap	½ oz.
Pearlash	2 dr.
Distilled water	16 fl. oz.

The print is laid upon a flat surface, such as a drawing board, and moistened with the liquid. The paper on which the reproduction is required is laid over this, and then a sheet of thicker paper placed on the top, and the whole rubbed evenly and hard with a blunt instrument, such as the bowl of a spoon, until the desired depth of color in the transfer is obtained. Another and more artistic process is to cover the print with a transparent sheet of material coated with wax, to trace out the pictures with a point, and to take rubbings of the same after powdering with plumbago.—Brit. and Col. Drug.

Transparent Photographic Prints.—The Photographic Times gives this method: If on albumen paper, soak the print overnight in a mixture of eight ounces of castor oil and one ounce of Canada balsam. Plain paper requires a much shorter time. When the print is thoroughly soaked, take it from the oil, drain well and lay it on the glass, face downward, and squeeze till all is driven out and the print adheres. If a curved glass is used, prepare a squeegee with edge parallel with the curvature of the glass. It will take several hours before the print is dry enough to apply color to it.

(2) Fix a paper photograph upon a cushion shaped glass with transparent cement; when dry, rub away two-thirds of the thickness of the photograph with sand paper. The thin film is then rendered transparent by soaking it in melted paraffin wax, after which transparent colors are applied, which appear softened down when looked at from the front. The background and heavier portions are then painted in body color upon the face of another cushion-shaped piece of glass, which is afterward fixed behind the first one.

For coloring photographs, The Era Formulary gives this process:

"Take any unmounted photographic print which it is desired to color and place it on a pane of glass, the face toward the glass. In this way the image will be seen through the back of the paper. With an ordinary pencil mark on the back of the print a rough tracing of the outlines of the photograph, marking the places where the colors must afterward be applied. When this tracing has been made, remove the photograph, lay it on blotting paper and apply the colors to the back of the print. The colors should be spread on in flat tints, it not being necessary to use demi-tints. For example, a flesh tint is put on the face and black or brown on the hair; if the picture is a landscape, the trees are colored dark green, the sky part blue. It is important to use strong colors, which will show through the paper better. After this operation is finished, and when the colors are dry, the photograph is rendered transparent as follows:

First prepare the following solution:

Benzine	10 parts.
White vaseline	1 "

The vaseline is dissolved in the liquid and then the mixture is ready for use. Then the photograph, which has been colored previously, is placed on some sheets of white paper, and the back of the picture is saturated first, pouring the solution on it and rubbing with the finger to cause the mixture to penetrate, first the color and then the paper. The print is then turned face upward, and this side is saturated in the same way. After this operation the paper becomes oily and transparent and the color begins to show through. It is left to soak thus for an hour or two, then both faces are rubbed with linen until no oily spots are seen, when the proof is placed on white paper. The operation is then completed and the proof has only to be pasted on cardboard, the same as other photographs. But, as the paper is still saturated with vaseline, water paste will not answer, and the same kind of varnish will have to be used. This process of painting, which can be used by anyone, gives very beautiful effects. Colors which are thus applied to the back of the photograph give it a tone of admirable freshness, and the vaseline mixture brings the image out. Besides, as the colors have the thickness of the paper to pass through, they are greatly softened and thus approach nature. The variations of the tints will be seen, by transparency, when looking at the picture. As to the colors, any that are at hand can be used, whether water colors or oil colors. The essential point is to choose the strongest colors, rose, green, etc., and to put on only a very thin layer, as otherwise the vaseline cannot pass through it.—Pharmaceutical Era.

Yellow Coloring for Beverages.—The coloring agents employed are fustic, saffron, turmeric, quercitron and the various aniline dyes. Here are some formulas:

(1)	Saffron	1 oz.
	Deodorized alcohol	6 fl. oz.
	Distilled water	4 "

Mix alcohol and water, and then add the saffron. Allow the mixture to stand in a warm place for several days, shaking occasionally; then filter. The tincture thus prepared has a deep orange color, and when diluted or used in small quantities gives a beautiful yellow tint to sirups, etc.

(2)	Ground fustic wood	1½ ounces.
	Deodorized alcohol	4 fl. ounces.
	Distilled water	4 "

This color may be made in the same manner as the liquid saffron, and is a fine coloring for many purposes.

(3)	Turmeric powder	2 ounces.
	Alcohol, dilute	16 "

Macerate for several days, agitating frequently, and filter. For some beverages the addition of this tincture is not to be recommended, as it possesses a very spicy taste.

The non-poisonous aniline dyes recommended for coloring confectionery, beverages, liquors, essences, etc., yellow are those known as acid yellow R and tropeolin 000 (orange I).—Pharmaceutical Era.

THE EMPEROR WILLIAM MONUMENTS AT MAGDEBURG AND COBLENZ.

THE year now drawing to a close has been signalized by two events of considerable importance. The sixtieth anniversary of the reign of Queen Victoria was celebrated in England during the summer with ceremonies befitting this extraordinary event, and about the same time Germany was making a fête day of the centennial anniversary of the birth of the great Emperor William. This occasion had a double meaning to the German race and signified not only a token of remembrance to him whom they regarded as a great and good man, but stood as well a memorial of the birth of the great German empire. It was a befitting time to raise substantial memorials, and monuments have been erected to the memory of Emperor William in all parts of Germany. Many of these monuments are large and magnificent, and we have already published quite a number of them in the pages of the SCIENTIFIC AMERICAN and SUPPLEMENT. We take pleasure in presenting to our readers two imposing monuments which have recently been dedicated to the public.

THE EMPEROR WILLIAM MONUMENT AT MAGDEBURG.

Of the two, one is at Magdeburg, the other at Coblenz. Thus each represents a different style of work, as a glance at our illustrations will prove. The Magdeburg monument, which was unveiled on August 25, was designed by Herr Rudolf Siemering and is distinguished mainly by its tasteful simplicity. It has been placed on the main square of the northern part of the city, outside the old fortifications. The site is very favorable, the background of the monument being very appropriately occupied by a fine building.

The erection of a monument to the old emperor by the city of Magdeburg was planned very soon after his death, as early as the 24th of March, 1888 (William I died on the 9th of the same month). Three months after, on the 19th of June, voluntary contributors placed in the hands of the committee formed in connection with the enterprise a sum of $50,000. Siemering was requested to hand in plans for a suitable monument. He complied, and, his design being approved of, the execution of the work was committed to his charge. The site chosen was at the time as yet free from buildings, but it was hoped that before the completion of the monument suitable surroundings would have grown up. And this hope we see was realized.

As regards the monument itself, certainly its most striking element is simplicity. The absence of a great number of details of secondary or, at any rate, only ornamental importance results in a concentration of the attention of the beholder on the main figure, Emperor William the First, arrayed in his uniform and mounted on a noble steed. The arms of the German empire, those of the city of Magdeburg, and a simple dedication on each side, are the only decorations which the artist has given to the pedestal.

The dimensions of the various parts we extract from Ueber Land und Meer, to which publication we are also indebted for our cuts. The length of the pedestal, measured at the height of the inscription, is 13 feet, the breadth at the same height is 4 feet 6 inches. The ascending stairs, which form a base, are 32 feet by 20. The point of the emperor's helmet is 32 feet above the level of the street; the statue, with the horse, measures 15 feet in height.

The effect of the whole is completed by a relief which runs across from left to right at the back of the monument. This relief has an interesting history. It was modeled by the artist in 1870 at the time of the calling out of the army, and produced quite a sensation at the time. But it was never until the present occasion worked out in stone. There it now stands, reminding the nation of one of the greatest events in her history during the reign of the great emperor.

The statue was cast by the Lauchhammer Iron Foundry, of an alloy of aluminum, tin and copper. The granite was shaped by the firm Kessel & Röhl, of Berlin, the stone being the brownish red Wanewyk granite from Sweden. The platform surrounding the pedestal is inlaid with a mosaic by Rudolf Leistner.

To turn to the Coblenz monument, we find in it altogether another style of work. A massive architectural pedestal raises the figures aloft, and as the monument stands on the peninsula formed by the junction of the Rhine and the Moselle, a very fine distant view across the water is obtained from several points. In details also this monument differs considerably from the one at Magdeburg. The figures, of which there are two, are placed immediately on the architectural base. This latter is a large square structure, to which flights of steps ascend from all sides. It is made of large stones and consists of two parts, one a raised platform, around the sides of which runs the inscription, "Wilhelm dem Grossen;" the other, the pedestal proper, consisting of a number of low and massive columns. Those which form the corners are more massive yet than the others and bear decorative shields. Below the inscription "Kaiser Wilhelm dem Grossen" is a relief representing an eagle spreading his wings in protection over a crowd of men fleeing from a hydra.

The statues stand on a level 94 feet above the river, and the equestrian statue of the emperor is 45 feet high. The other, a winged allegorical figure, bearing the laurel wreathed imperial crown, is 30 feet high.

The statues were cast by A. Hinkleben, of Brunswick, according to a design by Hundrieser & Schmitz. The stone is partly granite from the Black Forest and partly basalt. The total expenses of the erection of the monument, amounting to $475,000, were covered by the surplus of interest of the Landes Bank.

These two monuments are a fitting tribute paid by two important German cities to the memory of the emperor under whose rule the ancient realm regained by the sword its former power, to settle into a time of peace and prosperity.

RELIEFS ON THE EMPEROR WILLIAM MONUMENT.

TREATMENT OF LOW GRADE ORES BY CONCENTRATION.

THE above is the title of a paper read by E. B. Kirby, of Denver, Col., at the recent meeting of the International Gold Mining Convention in that city. The following is a condensation of the article:

It is well understood that most ores of the precious metals are composed of rock with mineral crystals distributed through it. These minerals present in any particular ore may comprise one of several out of a large list. As a matter of fact, there are four which are so common and prevail so universally in mining districts that few mills have to deal with any others. These minerals named in order of frequency with which they occur are pyrite (iron sulphide), blende (zinc sulphide), galena (lead sulphide), and chalcopyrite (copper and iron sulphide).

Each of these minerals may contain both gold and silver, but pyrite and chalcopyrite are the common carriers of gold, while galena and blende have a special affinity for silver. It is also well known that in unoxidized or sulphide ores the gold and silver contents are not distributed uniformly through the mass, but are generally confined to these mineral crystals. By crushing the ore and separating out the valuable crystals from the waste material or gangue its value is concentrated into their small bulk. This will bear the expense of shipping and smelting or of treatment by the more expensive processes.

Concentration milling is, therefore, the most important of all processes applied to low grade gold and silver ores. It is of the same fundamental importance here as in the field of simple lead, copper and zinc ores. It is of more general application than any other process, and by one simple treatment, performed at the mine, it gets rid of the mass of valueless gangue. The cost ranges from 20 cents to \$1.50 per ton, according to the capacity of the mill and the system employed. It is, therefore, the cheapest of all processes, with the single exception of free gold stamp amalgamation, which costs from 35 cents to \$1.25 per ton and produces a product in the form of bullion which requires no further treatment. The more expensive processes of pan amalgamation, barrel chlorination, cyanide and smelting entail an expense per ton of ore which greatly exceeds that of concentration. The latter will always maintain its superiority in cheapness, and also in its range of application. The other processes find their special field in the treatment of concentrates, or of high grade ore, or of ores which are of exceptional character, and do not yield their values to the simple operation of concentration or free milling. The gold ores of Mercur, or of Cripple Creek, or the quartzite ores of the Black Hills, together with the oxidized lead and heavy sulphide ores of various districts, are illustrations of the latter class.

Before mining men it is unnecessary to dwell upon the extent of our resources in low grade ores of gold and silver. All realize the opportunities they present for the future application of capital. The majority of these ores can be utilized only by concentration milling. As costs lower and extraction improves they will be gradually brought into use. But the extreme economies in mining and milling can only be secured by operating with modern skill upon a very large scale, and this requires a large capital. Hence, these resources are not waiting for the invention of some new and magic process. The process is already at hand. According to the skill and capital with which it is applied, it can now be made to yield almost any results within reason.

The more recent processes, like barrel chlorination and cyanide, together with their various modifications, have developed so rapidly within a few years that they have attracted great attention. Much has been written and published about them, and the mining world is already well informed upon the latest methods, results and costs of each one. Concentration, although of more importance and more widely applied, has not progressed in such a startling way. The general mining public have, therefore, had less information upon its present development.

In crushing ore for the process, it must be broken fine enough to free the mineral crystals from the gangue. For most ores the size necessary for this purpose is quite small, so that the crushing unavoidably produces a large percentage of flour or slime. Moreover, this slime generally contains the richest minerals present in the ore, because these are more soft and pliable than the quartz. Slime requires the most elaborate and expensive machinery for its treatment. It has to be handled more slowly and is subject to heavier losses than grains of larger size.

The problem always presented, therefore, is how to crush so as to liberate all the mineral, but at the same time to avoid a large slime production.

These objects are secured by making use of one or both of the two following methods:

1. The ore is subjected to an operation of part crushing, which is repeated several times. After each operation the grains which are small enough are sifted out.

2. The ore is crushed to a size somewhat larger than that necessary to liberate all the included material, and the oversized grains are then subjected to a rough concentration on jigs. This takes out the liberated mineral and thus promptly withdraws most of the values from the danger of further crushing. The impoverished grains are then crushed again to the proper size and concentrated.

Each of these methods calls for a more complicated and expensive crushing plant. How far their advantages outweigh the cheapness and simplicity of crushing to the final size in a single operation is always a question for calculation and experienced judgment. In general it is to be noted that American mills differ from those of Europe in showing a marked preference for the more simple plan.

The grains of the crushed mass range in size from the crushing limit of, say, $\frac{1}{4}$ in. diameter down to microscopic flour. They possess two properties, and only two, upon which it is possible to operate. These properties are size and specific gravity. It is, therefore, necessary to operate first on one and then on the other. Strictly speaking, it is impossible to effect any separation by acting upon both at the same time. For instance, a grain of pyrites is heavier than quartz, if the two grains are of the same size, and it will therefore fall more quickly in water. But it is not heavier than a very large quartz grain, and, if two such unequal grains fall together, the quartz will fall more rapidly.

Hence, in order to make a separation, it is always necessary to perform two distinct operations in succes-

INAUGURATION OF THE EMPEROR WILLIAM MONUMENT AT COBLENZ.

sion upon the crushed grains. The order adopted is not an essential matter, and concentration is therefore effected either by sizing and then sorting or, on the other hand, by first sorting and then sizing. According to one plan, the grains are first divided into a number of different sizes. Each size is then subjected to the sorting effect of a fall in water, which separates all the quick falling mineral grains from the slow falling rock.

By the reverse method the grains are first sorted into a number of classes, each of which includes those grains which fall in water at the same velocity. It takes a large grain of the light quartz to fall at the same speed as a small grain of the heavy pyrites; so that in each equal falling class the quartz grains are all of larger size than the pyrites grains. The subsequent operation of sizing, performed on each class, separates the large grains from the small ones and completes the concentration.

These well known principles are simple enough and the two operations required do not seem difficult. Nevertheless, there is a great variety in the machinery and apparatus for performing each one. In practice the work of a concentrating mill is rarely confined to these two simple operations. It is complicated in various ways. If one operation is not done well, those which follow it suffer. Imperfect work, therefore, often makes it necessary to repeat the series. There is a large class of grains in which the crushing has failed to break the mineral from the rock. The grain, therefore, has an intermediate specific gravity and does not find its proper place. Other grains have peculiar shapes, which alter their rate of fall in water. Such middling products must be provided for and require special treatment. Most ores are more difficult than the simple case of quartz and pyrites. The differences in specific gravity are slight, or it may be necessary to separate several minerals not only from the gangue, but also from each other.

For the operation of sizing grains, screens are naturally employed whenever it is possible to use them. In practice screens do not work well on grains smaller than coarse sand. Inclined plane sizing machines are, therefore, used for all fine material.

Machines of this class have an inclined plane over which a very thin sheet or film of water is made to flow. This sheet of water is only one-twentieth of an inch thick and moves most rapidly at its upper surface. At the bottom, where it is in contact with the inclined plane, the water flows more slowly on account of friction. When grains of different size are treated, the large grains, resting on the inclined plane, reach into the quick moving part of the stream and are rolled down the slope. The small grains lying in the slow moving region, close to the bottom, roll more slowly or not at all. The small grains which thus remain upon the inclined surface are either allowed to accumulate, as in hand or intermittent buddles of all kinds, or they are removed automatically by various methods. In one class of machines percussion or jerking movements are applied to the table. They cause the deposited grains to crawl out of the way and thus discharge themselves. In revolving buddle and belt machines the surface itself moves slowly from under the depositing current and thus carries its deposit to the discharging point.

All these appliances, when used according to the scientific principles of concentration, are sizing machines, and the grains which deposit upon them do so because of their smaller size, and not because of their greater specific gravity. In order to secure good results from them it is, therefore, necessary to treat only grains which are equal in falling and in which the mineral grains are consequently all smaller than those of the rock. It follows that they cannot do good work unless the preliminary sorting has been well done.

The second fundamental operation of sorting is performed either by hydraulic classifiers or by jigs. There are two leading varieties of hydraulic classifiers. Those of one kind sort by allowing the grains to fall in a deep on-flowing stream of water. This deposits the quick-falling grains near its head and carries the slow-settling grains further on. Each class of grains is, therefore, deposited at a different point. Another type of classifiers subjects the grains to a series of rising currents of different velocity. Each of these is adjusted so that grains of a certain falling speed will sink through it while the others are carried on.

The jig, though a simple machine, is remarkably efficient; and, unlike classifiers, it does its work very perfectly. It is most remarkable for the fact that, like a jack knife, it can be applied to a variety of uses. It will either sort or size, according to the way it is used. Moreover, it can be made to do good sorting on grains which vary greatly in size. The complex laws of jig action have been the subject of elaborate scientific investigations which are not within the province of the limits of this paper. The greatest American improvements in concentration, however, are based upon certain methods of utilizing jigs. It is, therefore, necessary to refer briefly to the main features of their action.

Mining men are familiar enough with the machine itself, which, in its present form, is very simple. Two to four flat stationary sieves, arranged in a row, are partly submerged in a box or tank of water. The stream which conveys the grains to be jigged is led upon the first sieve of the series and flows along the row to the point of discharge. By means of large pistons applied to the water in the box, it is caused to pulsate or rise up and down in rapid succession through the apertures of the sieves. At each pulsation the entire mass of grains resting upon the sieve is suddenly lifted up a short distance by the water, and is then allowed to fall back upon the sieve. The more rapid falling grains gain a little upon the others during each fall, and finally reach the bottom of the mass. Grains too large to pass the sieve accumulate upon it and are discharged by simple devices. Small grains which pass through the sieve fall into the body or "hutch" of the jig and are drawn off below as "hutchwork." The slow-falling grains accumulate at the top of the mass and are carried off by the outflowing stream. For some purposes it is necessary to have the water sink down again after each lift. The fast-falling grains are thus drawn down more rapidly by its quick suction. For other work this down suction is injurious. The machine is then so arranged that it will merely give a series of sharp lifts, after each of which the water either falls back slowly or remains stationary.

The jig is applied to three classes of work:

1. It is used to sort grains of the same size, and in this case each jig is fed with one of the sizes produced by the screening apparatus. When such equal sized grains are jigged, the quick-falling mineral grains promptly descend to the bottom of the mass.

2. It is used to size the grains of an equal falling class which are delivered to it from a hydraulic classifier. In order to accomplish this work each sieve is provided with a permanent bed or layer composed of large grains of heavy mineral. The interstices between these large grains have much the same effect as a sieve. The small or mineral grains descend through them against the rising currents and finally pass into the hutch.

In the German system of concentration the use of jigs is restricted to the two aforesaid operations. There is, however, a third way of using jigs known as the English method of jigging. This is because it was most extensively practiced in the mining districts of Great Britain and attracted attention because of the remarkable results of the old fashioned hand jig. American practice has taken up and improved this method of jigging and made it the basis for one of the most efficient modern systems of concentration.

In this method the jig is not fed with grains which have been previously either sized or sorted. On the contrary, it treats the entire mass of material just as it comes from the crushing machinery, and includes grains of all sizes and all specific gravities. A heavy bed of coarse grains is kept upon each sieve and the water pulsations are arranged so as to give a downward suction after each lift. It is found that those grains which are too large to penetrate the interstices of the bed are near enough to the same size to separate very well upon it. The sands and slimes which do enter the interstices are subjected to peculiar laws of fall and of suction which prevail in such restricted channels. The result is that the mineral grains of greatest specific gravity pass through into the hutch, while the others are driven back and carried off in the tailings. The action of currents in these interstitial spaces has a very singular effect. They lessen the influence which differences in grain size usually have upon their falling speed. In consequence it becomes possible to thus operate at once upon the specific gravity of grains which differ very greatly in size. The very finest slime, however, cannot be concentrated in this way, and must be separated and treated by the usual methods.

The hutchwork concentrates which have been made with such an apparent disregard of size are not very clean, and require another treatment in order to yield a pure product. This is done by the simple plan of repeating the same operation with some slight differences in its details. The impure hutchwork from the roughing jigs is delivered continuously to finishing jigs placed at a lower level. These complete the work and produce clean concentrates.

But one class of machinery remains for consideration, and this is important, because it has found its chief use in the stamp mills of the West. It is, therefore, the basis for what might be termed the stamp mill system of concentration. This class includes vanners, pumping tables, and shaking and jerking tables, of many designs. They are intended to treat only finely crushed material like sand and slime. They do excellent work on assorted grains. Moreover, they do not perform a single fundamental operation, like sizing or sorting. On the contrary, each machine performs two operations in succession, one of which might be termed "settling," while the other is an imperfect zigzag, generally called "washing." Machines of this class maintain a flat, shallow stream of water, which flows down an inclined surface. This stream is not a thin sheet or film, as in the zigzag machine previously described, but it is from one-half to three-fourths of an inch thick. The crushed material is generally treated as it comes from the stamps and without any preliminary sorting. As the grains settle out of the stream, they are prevented from packing and are kept in a semifluid condition by shaking, bumping or jerking movements imparted to the inclined surface. The effect is rather complicated. The quick-falling grains, whether large or small, tend to work to the bottom of the mass, while the small grains tend to sift down through the interstices of the larger ones.

There is no clear or definite separation, but as a final result most of the mineral grains sink beneath the top layer and accumulate near the bottom. This enriched bottom layer is gradually drawn out from under the settling stream. This is effected either by the gradual travel of the surface or belt, as in vanners, or by the crawling action of the grains themselves, caused by the bumps or jerks. The concentrates thus produced by this "settling" operation are impure and have to be cleansed by "washing." This is done on the same machine just before discharge, generally by a thin sheet of water applied in jets. The precise effect of this "washing" varies with the movement and the surface used, and is too complex for analysis here. In most cases it is a quick and imperfect sizing. Although each of the aforesaid operations is imperfect in itself, the two in succession effect a very satisfactory concentration upon fine crushed and unsorted grains.

When machines of this class are fed with equal falling grains produced by a hydraulic classifier, they then become very efficient sizing machines and the concentration is greatly improved. When acting upon sorted grains, the settling operation causes the small grains to work through and under the large ones. The final quick washing by a thin sheet of water upon the inclined plane of the machine is, of course, a sizing action, and in this case it is not complicated by the presence of unsorted grains. Vanners, which are the best known of these machines, have found an extensive use for treating sorted grains in complete concentrating mills.

Gold and silver stamp mills operate upon ore which contains either free gold or silver in forms which will yield to the process of amalgamation with mercury. But very few ores found at the present time are strictly free milling, and as a rule part of the values are contained in sulphide crystals. It is, therefore, generally necessary to supplement amalgamation by the concentration process.

Amalgamations require very fine crushing, and therefore furnishes material very difficult to concentrate. Moreover, there are many stamp mills which are designed solely for concentration, in which this fine crushing has been adopted because the minerals are finely disseminated through the ore. When such fine material is to be concentrated, the standard German system for treating sands and slimes, if properly designed, will generally secure the best extraction. At Western mills, however, simplicity of plant is a very important matter. The general preference is, therefore, for machines of the class just described, which have the advantage of giving good working results on unsorted or poorly sorted material.

In many cases this desire for simplicity has been carried too far. These machines save more and have greater capacity when they are fed with properly sorted grains. To introduce hydraulic classifiers in a mill causes some complications, particularly when the mill has not been built for their use. The plant also requires more attention and skill. There are few cases, however, when the increased saving will not more than offset these disadvantages. When hydraulic classifiers are adopted, it then becomes a question whether the standard German sizing machines are not best for these sorted grains. Here opinions differ. Rittinger percussion tables, belt percussion tables and revolving buddles now become rivals of the Western vanners, bumping and shaking tables. It may be well to observe that upon most sorted grains both classes of machines do good work. In treating the very finest slime, however, the inclined plane sizing machines, when properly adjusted, appear to have the advantage.

In reviewing the standard machinery and operations of the process, the Missouri and the stamp mill systems have been described. The other two are now easily understood.

The German system is the one most generally used, even in this country. In this system all large grains are first carefully sized by screens. Each of the many sizes is then sorted on a jig. The smaller grains, from sand size down, are, on the contrary, treated by reversing these operations. They are first sorted by hydraulic classifiers, and each class is then treated in a sizing machine designed for it. Those classes which include the large sands are put through jigs, which are operated as to size, instead of sorting the grains. The fine sand and slime classes are treated upon the standard inclined plane sizing machines, such as Rittinger percussion tables, continuous belt percussion tables and revolving buddles.

The German system requires a complicated plant, which has a comparatively small tonnage for the money invested. The cost per ton is also great, but against these faults it presents the advantage of effecting a closer saving than other systems. It is also preferred for difficult work; when the differences in specific gravity are slight, or when several minerals have to be separated, not only from the gangue, but also from each other.

The Lake Superior system was evolved to treat great quantities of ore with a more simple plant. The ore is crushed by steam plants, each head having a capacity of 300 tons daily. The grains, both large and small, are at once sorted into equal falling classes by hydraulic classifiers. Without entering into the peculiar details of Lake Superior jigging, it is sufficient to say that each class of large grains is put through a jig, whose principal function is sizing. This action is complicated somewhat on account of the fact that the preliminary sorting is not very perfect. The concentrates discharged from the hutches of these first jigs are not all pure. Some of the hutchwork is therefore treated again upon finishing jigs set at a lower level. The fine slime and sand classes are sized on revolving buddles, as in the German system. In some mills the hutchwork from the roughing jigs is sorted by hydraulic classifiers before it goes to the finishing jigs.

The mill of the Calumet and Hecla mine has a capacity of 6,000 tons of ore per day, and the cost is under 20 cents per ton. This system has also supplanted the German at the copper silver mines of the Anaconda Company in Montana and also at the Butte reduction works. The Anaconda concentrating plant has a capacity of 6,000 to 7,000 tons daily.

This system, together with that used in the Missouri lead and zinc regions, is specially adapted to ores which concentrate easily and do not require fine crushing. Constant improvements are being made in their efficiency, and on suitable ores they may yet rival the German system in close savings. It is impossible to discuss the numerous technical points which determine the question of choice, but it is well to call attention to the fact that the Missouri system is specially adapted to many gold and silver ores of the West. It is, therefore, sure to find a more extended use in this field. A plant of the most simple description applied to suitable ores will give satisfactory results. Through the Missouri mining districts numerous cheap but money making mills may be seen which include only a crushing plant and two to four jigs.

Irrespective of the system used, there is a radical distinction between American and European mills in the fact that the latter are intended to save all that is possible out of an ore. There is plenty of capital for elaborate and expensive plants, which will accomplish this purpose, and they are not run at the high pressure which prevails here. American mills are built for a different purpose. In our mining regions capital is scarce, while there is a superabundance of ore. The problem presented is always how to make money most rapidly out of the limited amount of capital which happens to be at hand for mill building. In general, it is most profitable to handle a large tonnage at the sacrifice of close savings, and mills are therefore arranged for this purpose. Even when designed to extract a high percentage of values, it is afterward generally found best to crowd the machinery beyond its normal capacity, at the sacrifice of its efficiency.

Generally speaking, therefore, the tailings losses of well designed American mills do not result from any lack of knowledge or skill. The principal losses occur in two ways: In the mineral crystals which remain included in the coarse grains and in the imperfect concentration of the fine sand and slimes. The first loss can only be remedied by recrushing and reconcentrating the coarse jig tailings. The second loss may be prevented by the use of more elaborate machinery for treating the fine material. Each remedy calls for more capital, and, when this is available, it is generally found better to use it for increasing the entire mill capacity, instead of perfecting these details.

In conclusion, it may be said that the selection of the

best system for any particular ore, and the question of how elaborate and perfect the mill shall be, are matters which call for careful judgment. Any error here results in a failure to secure the best paying mill for the money invested. Moreover, in no process is it so necessary to fit the mill to the ore. No two ores break alike or require the same outfit of machinery in each department of the mill. The selection and arrangement of machines and apparatus, the percentage which will be saved and technical details too numerous to mention all depend on the special character of the ore. In modern mill designs all these metallurgical questions are settled before building, and both the results and the cost of a mill may be known as accurately beforehand as in the case of any ordinary factory.—Mining and Scientific Press.

"HUMANIZED" MILK.

ITS COMPOSITION AND METHOD OF PRODUCTION, ERRORS TO BE AVOIDED, USEFUL INFORMATION ON THE VARIOUS PHASES OF AN IMPORTANT SUBJECT.

By HAROLD STACEY, Ph.G.

IN view of the fact that it has of late frequently been suggested that the pharmacist might with advantage prepare an artificial humanized milk for infants, it seems advisable to briefly review the literature on the subject and suggest working formulæ for those pharmacists who care to take up this subject.

CONSTITUENTS OF COW'S AND HUMAN MILK.

In the first place it is necessary to know the average composition of human milk and that of the cow, the latter of which is to be "humanized." The following table, based on analyses by J. Konig, shows the average composition of the two fluids:

	Human.	Cow.
Water	87·41	87·17
Casein	1·03	3·02
Albumen	1·26	0·53
Fat	3·78	3·69
Milk sugar	6·21	4·88
Ash	0·31	0·71

The table shows that in order to humanize cow's milk it is necessary to increase the amount of milk sugar, decrease that of the casein and albumen (these two bodies being usually tabulated together as "casein" or "albuminous constituents"), and at the same time maintain the amount of fat in statu quo.

THE PROCESS.

This may be accomplished in two ways, either by removing the casein by means of rennet and adding milk sugar or by diluting the milk with water and adding the requisite amount of fat and sugar to the diluted milk. The first method, while yielding a finer product, is not adapted to commercial ends, owing to the length of time necessary for preparation and to the expense attendant. The process is briefly as follows:

Take one pint of milk, from which the cream has been removed, and add sufficient rennet to precipitate the casein. Remove the curd, and in the whey dissolve 280 grains of milk sugar, and add this solution to two pints of new milk, subsequently adding the cream which had been removed. In this way a milk is obtained which has the following composition:

Water	87·17
Casein and albumen	2·37
Fat	3·69
Milk sugar	6·21
Ash	0·71

It will be noticed that this resembles very closely human milk in composition, the casein having been reduced one-third and the milk sugar increased from 4·88 to 6·21 per cent., while the amount of fat has remained unchanged. A simpler and in some ways more satisfactory method of reducing the percentage of casein is by dilution of the milk with water, the diminution in the percentage of fat being afterward made up by addition of fresh cream or butter. It is claimed that by diluting the milk with water it is altered in such a way that the casein coagulates in a similar manner to human milk, the coagulum of the latter being looser and more flocculent than that formed from cow's milk under ordinary conditions.

WORKING FORMULAS.

To reduce the content of casein in cow's milk to the same percentage as that of human milk, it is necessary to add three parts of water to every five parts of milk. The fat and milk sugar are naturally diminished, and the requisite percentage must be made up by addition of more milk sugar and fat. The latter is added either in the form of cream or butter, preferably the latter, owing to its more constant composition. It is readily emulsified by the milk. The following forms a good working formula:

New milk	2 pints.
Fresh butter	3 drachms.
Milk sugar	500 grains.
Water	19 ounces.

Dissolve the milk sugar in the water and add to the milk and butter previously emulsified. If cream be used, the following formula, given by Plague, will be found to work well:

New milk	3 ounces.
Cream	1½ ounces.
Milk sugar	1⅛ ounces.
Water	18 ounces.

Mix secundum artem.

TO MAKE UP THE DEFICIENCY IN FAT.

Soxhlet objects to the addition of fat to the diluted milk, and suggests that additional milk sugar be added to make up for the deficiency in fat. He states that milk containing an abnormal amount of fat cannot be sterilized without the fat becoming partially separated, and the state of emulsion so necessary to assimilation being disturbed. All the functions performed by fat are equally well performed by carbohydrate material, and to make up the deficiency in fat an isodynamic amount of milk sugar must be added to the diluted milk. According to Rubners, 243 parts of milk sugar are isodynamic with 100 parts of fat; consequently, a deficiency of 1·32 per cent. of fat may be made good by an addition of 3·19 per cent. of milk sugar. Soxhlet, therefore, advocates a milk preparation as follows: Prepare a solution of milk sugar in water of the strength of 12·8 per cent., and to every two parts of milk add one part of this solution. The resulting fluid will have this composition:

Water	85·30
Casein	2·37
Fat	2·46
Milk sugar	9·41
Ash	0·47

Such a milk possesses all the nutritive properties of human milk, is readily prepared and does away with all troublesome additions. Moreover, it coagulates in a very similar manner to human milk—a matter of the very greatest importance in infant feeding.

MINERAL CONSTITUENTS OF HUMANIZED MILK.

In the preparation of all of these "humanized milks," no mention has yet been made of the mineral constituents. This is of sufficient importance to warrant special attention. Human milk is alkaline to litmus, containing only one-sixth of the amount of lime present in cow's milk and only about one third of the amount of acid phosphates. It is very important to correct this excess of acidity and mineral salts in preparing humanized from cow's milk. This may be best accomplished by addition of sodium bicarbonate. This alkali is preferable to lime water, as cow's milk already contains an excess of lime salts. The amount necessary for neutralization of the excess of acid salts is six grains to the pint. This addition should be made after the process of sterilization. Dr. A. E. Wright has advocated removal of part of the excess of lime salts present in cow's milk on the ground that the coagulum formed is less dense in proportion to the diminution in lime salts present. He advocated the addition to the milk of a small amount of sodium citrate. In the proportion of one part to 200 parts of milk, he finds that sodium citrate prevents any coagulation by rennet, and the addition cannot be readily detected by the palate. A much smaller proportion is sufficient to "humanize" cow's milk.

THE OBJECTION TO STARCH.

Attention may be directed here to the fact that certain writers on this subject have advised the addition to these artificial milks of various forms of carbohydrate food, such as oatmeal flour or decoction, arrowroot, barley water, and even meat broths of various kinds. Such additions can only be deprecated, seeing that the saliva of infants does not contain any ferment capable of converting starch into sugar or other assimilable form. Milk sugar is the only carbohydrate found in the milk of any animal, and if additional carbohydrate food is needed, it can best be supplied by increasing the amount of this constituent.

CONDENSED MILK AS INFANTS' FOOD.

A word must be said as to the use of condensed milks for infants' food. For many reasons these milks are not to be recommended. The processes which they are put through in their manufacture lead to considerable alteration in the character of the fluid. The casein becomes less readily precipitable and is less readily digested. Changes also occur in the character of the albumen, which is generally coagulated; the percentage of milk sugar is somewhat reduced and the fat is thrown out of its emulsified state to a greater or less extent in various brands. As a rule a portion of the fat is removed before concentration. More important than this is the probable destruction of the natural germicidal properties of the fresh milk and of its natural ferment.

The variation in composition is well shown by comparing the results here given of analyses of various brands:

	Water.	Casein.	Fat.	Milk sugar.	Ash.
1	56·71	13·18	14·13	13·98	2·00
2	55·43	14·00	13·16	14·84	2·53
3	56·01	13·90	14·02	14·06	2·01
4	52·07	14·26	15·06	16·97	2·80
5	57·86	8·50	16·02	16·32	2·20
6	51·72	11·00	14·38	10·51	2·75

(These brands were all unsweetened.)

It is impossible, where such variations in composition exist, to give working formulæ for humanizing the commercial condensed milk.

THE QUESTION OF STERILIZATION.

Of considerable importance in connection with preparation of humanized milks is the question of sterilization. So much has been written on this subject that more than a summary of the result arrived at is unnecessary. A valuable paper on this subject is that by Dr. Albert Leeds and Prof. Conn in the report of the Dairy Commission of the State of New Jersey for 1892 on the "Preservation of Milk," to which those interested are referred. After what has been said on the subject of condensed milks, it will suffice to say that a boiling temperature for sterilizing milk is highly undesirable, and experiments have shown that the most satisfactory method of preserving such milks is by the method of Pasteurization. By keeping the temperature below 70° C. (158° F.) the natural properties of the milk are but little affected, while the above temperature or a few degrees below will suffice to kill all pathogenic organisms likely to be present in milk. Preservatives are not recommended for addition to humanized milk, and in particular the use of formaldehyde to preserve milks intended for infant use should be condemned. This agent, even in minute amounts, has a most injurious action on the mucous membranes, converting them, if the action is constant, into a substance closely resembling leather and setting up severe irritation. Given to infants in milk, its action on the coats of the stomach cannot be other than injurious, even in the minutest amounts, and when used for this purpose may possibly prove to be the forerunner of lifelong dyspepsia.—American Druggist.

PRODUCTION OF COPPER PLATE VARNISHES.

FOR copper print varnishes, which must be still stronger than lithographic varnishes, old linseed oil or preferably nut oil is used; the latter is never employed alone, but mixed with linseed oil to give it more viscosity. According to the product desired, 12 to 50 per cent. of linseed oil is added.

The process of manufacture, as it is performed up to the present day, consists in heating the oil in a vessel holding about 25 liters, until it flashes or gives off white fumes that may be ignited. The oil is allowed to burn for five minutes, the vessel removed from the fire and placed upon a pile of ashes, where burning is allowed to continue for a few minutes more. Then slices of bread are put in the oil, one after the other, and each is left in until it has become brown, but not burnt; onions are also said to be employed. In practice this operation, which seems to be necessary, although no explanation can be had for it, is designated the "degraissage" of the oil. Now the vessel is covered and allowed to cool off, and a clear greenish oil, a little thicker than linseed oil, is received.

To obtain a thick (strong) oil, the oil when still showing the necessary heat is again lighted and allowed to burn five to ten minutes, stirring repeatedly, extinguishing the flame and lighting it again, and repeating this twice, sometimes even three to four times. The cooled oil draws threads like sirup. The grade called "huile grasse" is of inferior consistency, and is only lighted three times during its preparation.

In large works, however, this mode of production is no longer in use; the degraissage with bread has been supplanted by one with nitric acid or magnesia; the latter, mostly employed in England, is carried out by adding 2 per cent. of magnesia to the oil, leaving it to boil one hour, then pouring off or allowing to cool.

The oil is gradually heated to 180° C. in a kettle containing about 200 liters and is kept at this temperature for three hours. Then 500 grammes of finely pulverized bichromate of potash are added and the temperature raised to 300° C., a rising of the oil being prevented by pouring in small quantities of cold oil. After the temperature has been increased to 315°-320° C. during half an hour, 500 grammes Paris blue are still added. Now it is allowed to cool and thus the strong varnish ("huile forte") is obtained.

To produce "huile grasse," the temperature is maintained at 300° to 305° C. for only five minutes; for "huile claire," the temperature must not exceed 255° C., at which it is kept fifteen to thirty minutes, according to the purpose desired.

Villon gives the following proportions for the preparation of a fine copper plate printing ink (Frankfort black): 1,000 parts "huile claire," 250 parts "huile forte," 500 parts lampblack, 50 parts Paris blue, 25 parts resin soap.

The Paris blue and the "huile claire" are exposed, in a kettle provided with a stirrer and a double bottom, which can be heated by steam, to a temperature of 100° C.; the latter is then increased to 150° and the resin soap added, stirring incessantly. After the cooling, the lampblack and then the "huile forte" are added in a mixing machine and finely ground in a cylinder color grinder. For a less careful manufacture a common paint mill is sufficient.

Villon, who has made numerous researches, in order to obtain a copper printing ink of a deep black without a reddish tint, and which will keep well, has finally adopted the following composition, each ingredient of which has its significance: 1,000 parts huile claire, 200 parts huile forte, 23 parts carnauba wax, 35 parts paraffine, 25 parts resin soap, 4 parts violette de Paris, 40 parts Paris blue, 100 parts noir de Liége, 50 parts blutkohle (bloodcoal), 200 parts noir de lie, 150 parts boneblack.

A good many other substances, such as Canada balsam, ceresine, asphaltum, stearic acid, ozokerite, Japanese wax, have been proposed, to impart the necessary consistency to the composition.—Translated for the SCIENTIFIC AMERICAN SUPPLEMENT from the Färben Zeitung.

THE FUTURE OF PHOTOGRAPHY IN ITS APPLICATION TO MEDICINE.

PHOTOGRAPHY has come so rapidly forward of recent years as an aid to our senses, and in materially increasing the value of our observations, that no apology is needed for pointing out briefly the advantages which the practical study of the art would afford the medical student. The extremely sensitive photographic film only illustrates, after all, how dull is the perceptive power of the eye, and how far short of perfection it falls, considered in the light of an optical instrument. In recommending the student to practice photography we do not do so with any wish to burden him with another subject in his already crowded curriculum. We rather enjoin him to acquire a practical knowledge of photography because it tends to sharpen his powers of observation, to lead him to make faithful records, and to cultivate in him the artistic method. Indeed, we suggest it as a pleasant, instructive and recreative pursuit, and in these days of dry and rapid plates and of cheap yet good apparatus there is nothing so simple as taking a photograph and taking it well. Then, again, the student's recently acquired or freshened knowledge of chemistry will in no small measure enable him to obtain good results. At most medical schools now dark rooms are provided and other facilities afforded for taking photographs, since a knowledge of practical photography is found to be extremely useful in the dissecting room, in the post mortem room, in the ward, and in the operating theater, while the capacity to take a micro-photograph is essential in the practical study of bacteriology and physiology. Even in these applications photography may be pursued as a hobby, but what a useful hobby! It is but a simple step from the photograph to the block picture used for illustrating published communications, and in describing cases of surgical or of general medical interest photography again and again proves an invaluable aid.

We go a step farther than this, because the extreme sensitiveness of the photographic film has more recently laid bare certain phenomena which otherwise would probably to this date have remained unobserved. The phenomena we refer to are not interesting merely as

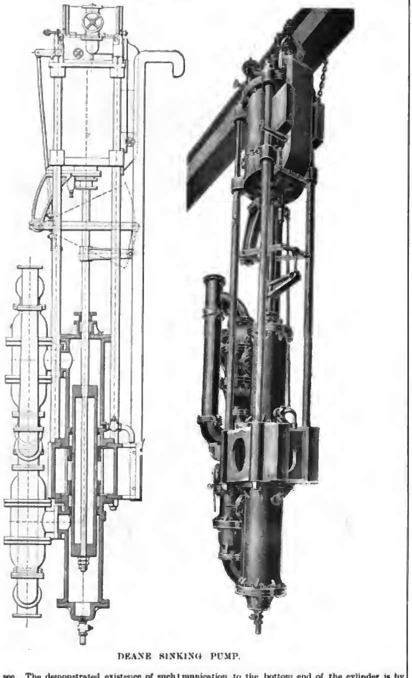
phenomena, but, as is now well known, they have led to a remarkable application of photography to the diagnosis of disease and to the discernment with more or less certainty of hidden anatomical abnormalities or even of pathological conditions. We refer to the X rays. In addition to a good sensitive plate, the student requires for this work a good induction coil and a vacuum tube, but the camera is no longer necessary. Indeed, for many purposes the sensitive plate may be dispensed with, since the rays may be made visible by means of the fluorescent screen. Examples of photographs showing the internal structure of the body, of the organs and the bones, or of hidden foreign bodies are now too familiar to need any further description. The discovery has brought to light one extremely important fact, namely, that there exist vibrations which are so rapid as to pass easily through what are otherwise opaque substances, and yet which fail to create an impression upon the optic nerve. But the sensitive plate reveals them, just as it records an infinitely greater number of stars than the eye is enabled by the best telescope to see. The demonstrated existence of such highly attenuated matter must have a profound influence upon our preconceived ideas of the nature of that mysterious thing, the elementary substance, or matter. Further, it has recently been shown that light or, at any rate, vibrations similar to it, are emitted by almost all substances. Perhaps the most remarkable example of this kind is afforded by uranium and its salts, which emit a peculiar kind of light which is dark to the eye, but which very distinctly affects the photographic plate. And, strangest thing of all, this property appears to be inexhaustible. Moreover, the radiations so obtained appear to be like the X rays, able to permeate such ordinary opaque substances as black paper, celluloid, etc.

Another most promising development in photography, and one which will probably have an important bearing on medicine, is the recently announced discovery of a process by which the objects photographed may be displayed in all the variety of their natural colors. It is quite evident that when the particulars of this process are made known, an additional means of great importance and value will be at the disposal of surgeons and physicians for making more exact pictorial records of surgical and anatomical cases and morbid specimens.—Lancet.

A LARGE SINKING PUMP.

The accompanying illustrations represent a large sinking pump recently constructed by the Pulsometer Engineering Company, Limited, of Nine Elms Ironworks, London, for a mine abroad. It is on the well known Deane system, with some modifications in the details of the valve gear to suit the purpose in view.

The steam cylinder is 36 in. diameter, and has a stroke of 36 in. The pump, which is double acting, is of the plunger pattern, and is outside packed. It is 11 in. diameter by 36 in. stroke. The valve boxes, which are provided with hand doors, are made separately, and are fitted with multiple valves. The valves of the cylinder are placed above, and form part of the top cover, in place of on the side, as is the usual practice. Communication to the bottom end of the cylinder is by means of a separate casting, as shown by the cuts, and, in the event of breakage, the parts, being separate, are easily replaced. The valves are worked by the simple arrangement of rod and lever as shown. The pump barrels are held together by the center casting, to which the rods for hanging the whole pump and attachments are also fixed, the rods going up and through bosses on the cylinder and above to the slinging links and eyes. The pump boxes are fitted with gun metal grids, on which work the extra thick rubber valves with plates and buffers on the top to lessen shock. The sinking operations are much simplified by the sliding suction pipe supplied with the pump, and being partly constructed of the Pulsometer Engineering Company's union pipe, is light and strong, and well suited for sinking purposes. The total height of lift is 400 ft.—The Engineer.



DEANE SINKING PUMP.

The first notice of the use of coal is in the records of the Abbey of Peterborough, in the year 850 A. D., which mention an item of 12 carloads of "fossil fuel."

FIVE THOUSAND CANDLE POWER "EMERGENCY" LIGHT.

The "Wells light" has now become so common, and proved so satisfactory, that surprise may be expressed at its makers bringing out another high candle power oil light working on a different principle. The new light, however, which we illustrate above, is not intended to replace the older one, but for use in circumstances where the 8 or 10 minutes needed for heating the vaporizer cannot be spared, as at fires, breakdowns, etc., where every minute of time becomes of serious import. The new lamp is a spray, and not a vapor lamp, and might accordingly be justly considered as

Fig. 1.

Fig. 2.

THE WELLS "EMERGENCY" LIGHT.

a case of atavism, as the first of all the high power oil lights was worked on this principle. As then constructed, however, the power required to produce the spray was considerable, while as now made by Messrs. A. C. Wells & Company, engineers, London and Manchester, a boy can easily maintain one of the lights in full activity. As shown in Fig. 1, the lamp consists of a reservoir containing oil, and fitted with an air pump, by means of which a pressure is maintained in the space above the oil. This pressure is then utilized to force the oil up to the burner in the usual way. At the same time, however, a second pipe coming from the top of the reservoir leads air to the sprayer, which completely breaks up and shatters the oil as it flows from the burner. A pilot light fitted with a wick is kept constantly burning, and immediately the cock shown on the standard is turned, the flame starts into full activity. Closing the cock puts out the flame instantly, so that the lamp can be used very conveniently for signaling purposes. The standard, with its oil and air tubes, can be completely detached from the air reservoir, the two tubes aforesaid passing into this reservoir through glands, as shown in the figure, which, on replacing the apparatus, only require tightening up for the lamp to be ready for use. The construction of the burner is shown in Fig. 2, which also exhibits clearly the position of the pilot light. The reservoir of the latter can be filled from the main one by opening the small valve shown at the back of the spray producer.—Engineering.

ELECTRIC CABS IN LONDON.

THE London Electrical Cab Company, some weeks ago, began to run fifteen electric cabs supplied by accumulators. We borrow an account of the arrange-

FIG. 1.—THE LONDON ELECTRIC CAB.

FIG. 2.—INSTALLATION OF THE MACHINES FOR CHARGING.

ments adopted from our contemporary The Electrical Review.

The vehicle, which is represented in Fig. 1, has the exact form of a coupe. The interior is tapestried, and at the side there are windows that can be opened and others that are fixed. The coachman sits in front. The battery employed consists of 40 accumulators of a capacity of 170 amperes hour with a discharge of 30 amperes. They are mounted in a box placed upon a support, which is suspended by means of springs beneath the cab. A 3 horse power Johnson-Lundell electric motor, with a doubly wound inductor and armature, is fixed to a box in the rear and actuates a transmission shaft through a train of gear wheels. This shaft is divided into two parts, each of which, through a chain, sets in motion one of the two hind wheels. The windings and the fields may in the first place be coupled in tension with a feeble resistance. This resistance may afterward be removed and the cab run at a speed of 2¾ miles an hour. With the armatures parallel and the fields in tension, 6½ miles an hour may be made. Finally, with the two fields in quantity, the cab may be run at a speed of 9⅔ miles an hour.

The accumulators have a total weight of 1,560 pounds, and the cab complete, inclusive of passengers, weighs 3,350 pounds.

Upon the left side is placed the starting lever. As soon as this is pushed forward, the cab starts off with a speed of from one mile to nine miles an hour. It suffices to reverse the lever and place it in the center in order to stop the cab at once. If the lever is pulled back, the motion of the cab is reversed. The brake is applied to the wheel through a pressure of the right foot; the electric current is then interrupted. The steering is done solely through the maneuver of a central hand wheel placed in front of the coachman. The management of the vehicle is very easy and simple. Out of fifteen coachmen selected, twelve, after two days' practice, were capable of running the cab. While at rest, the vehicle is kept locked, and it is impossible for anyone to set it in motion. The coachman has merely to put the keys in his pocket and leave the cab to itself.

The company that has introduced these electric cabs in London has not wished to produce its own electric energy, because, in the first place, the price charged per day by the electric companies is sufficiently low, and, in the second place, because the service, upon increasing, would necessitate charging stations throughout the entire city of London.

The first charging station has been established on

FIG. 3.—CAB DEPOT.

Juxon Street, Lambeth. The alternating current is furnished by the London Electric Supply Corporation at 2,400 volts and at a frequency of 83 periods per second. There have been installed two transformers, each composed of a Thomson-Houston alternating current motor directly actuating a continuous current dynamo of 75 kilowatts of the same manufacturers.

Fig. 2 gives a general view of the installation of the two transformers. The transformation of the electric energy of high tension with alternating currents into energy of low tension with continuous currents is effected with a rendering of 86 per cent.

Fig. 3 gives a view of the cab depot and Fig. 4 a view of the charging hall. The accumulator boxes have been taken from beneath the cabs, placed upon trucks and arranged along the walls in order to be recharged. The cost of the electric energy is three cents per kilowatt hour. With a complete charge, the cab

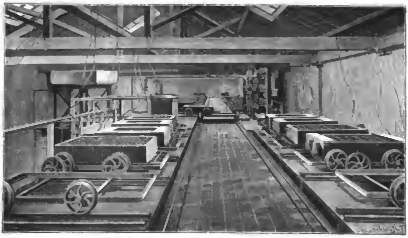


FIG. 4.—HALL IN WHICH THE ACCUMULATORS ARE CHARGED.

is capable of making a trip of 48 miles, at an expense of fifty cents.—La Nature.

THE REFRACTIVE INDEX AND REFLECTING POWER OF WATER AND ALCOHOL FOR ELECTRICAL WAVES.

THE electro-magnetic theory of light, as originally given by Maxwell, included only the optics of a single wave length, and required extension to justify and harmonize the facts of selective absorption and dispersion. This extension was made by Helmholtz. According to him, a change in the refractive index with the wave length is to be expected throughout the complete spectrum; but, beyond a certain wave length, these values approximate rapidly to a fixed limiting value, so that the index may be regarded as practically constant for longer waves. The period of this characteristic wave length is theoretically of the same magnitude as that of the slowest possible vibration of the molecule, but it is practically unknown. Yet recent researches render it probable that this close approximation to a constant limiting value is exhibited by wave lengths much smaller than all electrical waves thus far produced. It seems probable that the great change in the value of the refractive index occurs in a part of the spectrum much nearer light waves than the Hertz oscillations. Still, the researches of Gratz and Fomm (Wiedermann's Annalen, 1895) and of Drude (P. Drude, Wiedermann's Annalen, 1895) indicate a certain amount of dispersion, even for long electrical waves.

It seemed desirable, therefore, to investigate the refractive index of these substances, particularly of water and alcohol, to see if it is the same for very short electrical waves as for long ones. The work was consequently undertaken by A. D. Cole, in Prof. Warburg's laboratory, and partly under the guidance of Dr. Rubens, of the Berlin University. The paper describing the investigation is given in full in Wiedermann's Annalen der Physik und Chemie, 1896. It will scarcely suit our purpose to follow the author through the details of his work, and his minute description of the apparatus employed; we therefore simply notice that he investigates: 1. The velocity of long electrical waves in water and alcohol by the method of E. Cohn. 2. Refractive index for short electrical oscillations. 3. Reflecting power of a metal for electrical waves. 4. Reflection of electrical oscillations by liquid surfaces. The paper is illustrated by diagrams of the apparatus employed and by tables. Summarizing all the results, we find that: 1. For oscillations of 300 cm. to 600 cm. total wave length, the refractive index for water is 8·95, for alcohol 5·90. 2. For oscillations of 5 cm. wave length two Fresnel formulas give the same value for the refractive index from observations of energy reflected at 45 deg. For water this value is 8·85, for alcohol 3·2. 3. The refractive index of alcohol is decidedly greater for long than for short electrical oscillations. Clearly the research is not yet concluded. We understand, however, that the work will be resumed shortly.—Electrical Review, London.

The cylindrical car is in evidence again, this time on the electric railway at Concord, N. H. It is also a convertible car, built on the principle of a rolling top desk, the side panels sliding up grooved posts into the roof to form an open-sided summer car. In case of a rainstorm or sudden change of weather the sides can be promptly rolled down. There are transverse seats and a central gangway.

APPARATUS FOR THE STERILIZATION AND FILTRATION OF WATER.

In the matter of treating potable and industrial water, France was represented at the Brussels Exposition by the apparatus of the Delhotel system, to which Messrs. E. Fourey, Sons & Company, the manufacturers, have given the most practical form.

In all the installations in which the Delhotel & Moride filter is used for furnishing sterilized and filtered water the reagent employed is alum, which, mixed with the water in the mean proportion of four grains to the quart, frees it from its pathogenic germs. Alum not only exerts a physical action, but also destroys the vitality of the biological elements.

M. Lacour, in his remarkable researches upon the sterilization of water, has even succeeded in sterilizing filters with alum or with alcohol, which he finds preferable to heat, which, without being any surer, is more costly.

The reaction is very simple. In the presence of the carbonate of lime that almost all water contains, there forms a subsulphate of alumina insoluble in water, and sulphate of lime and sulphate of potash in infinitesimal proportion remain dissolved, and carbonic acid is disengaged. It is the subsulphate of alumina that is the sole active agent. It brings about the formation of a lake that envelops the organic and mineral substances in suspension.

In order that it may be rendered potable, water thus treated requires more than a decantation. Simple rest, even for a long time, does not suffice to free it from its mucilage, and filtration is necessary after the treatment.

There are two cases to be considered: It is possible to establish a reservoir of impure water of a determinate capacity placed above a filter which delivers the pure water to a second receptacle situated at a lower level. Into the reservoir of impure water is put the desired proportion of alum, previously dissolved in a small quantity of warm water. After this has been shaken for a few minutes, it is allowed to rest for a quarter of an hour before filtration.

Such an installation is somewhat cumbersome. Since, in reality, the chemical reaction is immediate, it is possible to establish an automatic distributer of the reagent upon the filter itself, provided that the latter be capable of freeing the water from the mucilage that envelops the micro-organisms. Now, both experiment and practice have shown that the Delhotel & Moride filter fully satisfies this condition without the gelatinous substance of the precipitate proving an obstacle to the normal operation, since the cleaning may be easily done while the apparatus is at work.

In the first description of the apparatus that we gave, an automatic distributer of the reagent was described. The one that we represent herewith is recent. In a cast iron receptacle, H, resistant to pressure and easily opened, there is a charging bucket, I, containing crystallized alum. All the impure water to be purified enters through the conduit, S. A small portion of the current passes through the cock, J, of the pipe, O, circulates over the alum and dissolves some of it. The largest discharge takes place through the cock, K, and mixes with the alumenized water in the conduit, M, ending at the filter.

The two cocks, J and K, are connected with each other through the cranks, Q, and the rod, P, which permit of regulating their respective discharges and of rendering their closing simultaneous. Besides, a cock, N, permits of perfecting the regulation of the water to be alumenized, which, through a conduit, L, is distributed by means of a perforated metallic pipe over the entire surface of the reagent and descends along the guide, G, in measure as the alum dissolves.

These cocks, having been regulated once for all, are registered. In this way there is obtained automatically, and without the necessity of any surveillance, a quantity of reagent proportional to the quantity of water to be treated.

A cock, R, interposed in the conduit, O, permits of the washing of the distributer with impure water. The distributer is charged for an operation of twenty-four hours at a minimum, and sometimes of seven days.

We shall now describe the arrangement of the Delhotel & Moride filter figured herewith.

This apparatus consists of an iron plate cylinder, A, capable of withstanding a pressure of five atmospheres, and in which there is a filtering mass, S, formed of finely pulverized silex. The water enters through the conduit, B, and the cock, 1, an annular tube, D, whence it makes its exit through four circumferential ajutages, a, having the form of an eolipyle. It traverses the sand, the collector, F, the tubulure, P, and the pipe, b, and makes its exit, filtered, through the conduit, C.

The collector consists of a cast iron disk supported by two squares riveted to the cylinder and upon which rests a perforated plate covered with fine wire gauze. Iron rings hold these different pieces by means of bolts and permit of easily changing the wire gauze. The disk, at its lower part, carries a tubulure, P, which, through friction, enters the corresponding tubulure of the conduit, b. The joint is formed with hackled flax or hemp or asbestos fiber.

In the interior of the collector there is a U-shaped piece which distributes the water introduced by the opposite current employed for the rapid cleaning, and which supports the perforated plate.

At the top of the central pipe, T, bolted to the bottom of the filter, there is mounted, through friction, a funnel, E, while below it is prolonged by a tube, of which the cock, 4, serves for the removal of the sand. By opening and closing this cock rapidly, it is possible, during the operation of the apparatus, to keep the surface of the sand clean. The water whirls rapidly upon its exit from the orifice of the ajutages of the eolipyle, and rises and drives the mud into the funnel, E, whence it flows to the exterior through the cock, 4. When it is desired to proceed with the complete cleaning of the filter, a counter current of water is employed. To this effect, the threeway cock, 1, is so maneuvered as to send the impure water into the conduit, J, and the cock, 3, for the filtered water is closed. The non-treated water enters the apparatus through the tubulure, b, flows under U, which distributes it through the collector, lifts the sand and washes it, and carries the impurities into the funnel, E.

In order to finish a washing through an opposite current, it is not necessary to wait for the water to make its exit, clear, through the cock, 4, since it can be arrested in a few minutes. The cock, 1, is then turned in such a way as to send the water upon the sand. Since at this moment the filtered water would pass in a turbid state for from one to ten minutes, the mud cock, 2, is opened so as to allow such water to flow to the sewer. When the water runs clear, this cock is closed, and the cock, 3, is opened in order that the normal operation may be resumed.

According to the pressure of the water disposable, the regulation of the opening of the cock, 1, is effected once for all, both for the sending of the water into the filter and for the washing. A graduation by index renders the registerings easy. If the filter should operate under too strong a pressure, as a consequence of a too wide an opening of this cock, the discharge would be too great, to the detriment of the clarification. As for the washing during the operation of the apparatus, too strong an opposite current might lift the sand to such a height that it would overflow into the funnel, while it should remain at a few fractions of an inch from the latter.

At the bottom of the apparatus there is a cock, protected against contact with the sand by fine wire gauze and serving for the complete discharge of the water in case the filter should have to be left for some time at rest.

Upon the cover there is a screw plug as well as a cock to allow of the exit of air.

The essential advantage of this apparatus consists in the facility with which it is possible, in less than a minute, to rid the filtering surface of its mucilaginous deposit. So it permits of successfully treating water that is very muddy or that is charged with chemical precipitates, without the necessity of having frequent recourse to cleaning by an opposite current.

No mechanical part involving any expense for manual labor or maintenance enters into the construction of this apparatus.

From the experiments made at the municipal laboratory of Paris, it results that the addition of a small quantity of sulphate of alumina to the water of the Seine (1/30,000 or 1/50,000) and a passage thereof through the filter under consideration, permit, with a

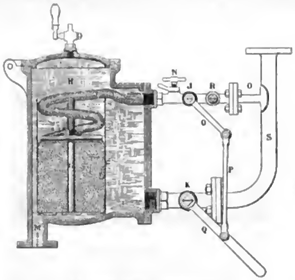


FIG. 1.—REAGENT DISTRIBUTER.

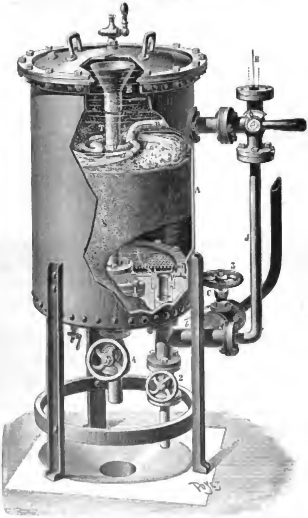


FIG. 2.—DELHOTEL & MORIDE FILTERING APPARATUS.

large discharge under a limited volume, of clarifying this water perfectly, of freeing it from the greater part of its taste and odor, of removing, at a minimum, 90 per cent. of the bacteria and of eliminating from ¼ to ⅓ per cent. of the organic matter without changing the hygrometric degree or sensibly modifying the proportion of the weights of sulphate and carbonate of lime contained in the water.

The sulphate of alumina added to the water is, moreover, entirely precipitated in the state of subsulphate, and there remains no trace of it in the purified water.—Revue Industrielle.

THE NOSE AND RESPIRATION.

IN the physical study of respiration it seems that authors formerly directed their researches only to the organs situated below the neck; in other words, all of them neglected the important study of the respiratory orifice. It seemed indifferent whether one breathed through the nose or the mouth or through both simultaneously. But within the last twenty years a new branch of medicine has been instituted, that of rhinology, the object of which is the study of affections of the nose. This specialty, the beginning of which was modest, soon established the conception that affections of the nose are not only the local diseases that they seem to be, but that they have constantly a reflex action upon the general health. In fact, children whose noses are chronically obstructed develop poorly and remain sickly. Adults who cannot breathe through the nose become asthmatic and cannot withstand prolonged exertion. Moreover, there is a notion prevalent that in order that a person may run well, the mouth must be closed and the breathing be done through the nose. Finally, we know that the victors in different sports are never those whose noses are obstructed. A series of researches recently published * permits of giving a simple explanation of all these facts, which are quite different in appearance. We have been able, in fact, to prove, by means of the processes indicated further along, that the nose is the natural organ of respiration, especially because it is so arranged as to allow of the passage, for a given time and for a given inspiratory effect, of a larger quantity of air than the mouth. In other words, the buccal orifice standing for 1, the normal nose should stand for about 1·25. It will be at once seen to what a loss of air one is exposed by an inspiration that is exclusively buccal or that is effected through a nose of reduced capacity—a case of exceedingly frequent occurrence. Such an assertion may seem paradoxical. In fact, in order to respire with full lungs, do we not open the mouth widely? and have we not thus a sensation of inhaling a larger volume of air? At this moment, the inspiration is quite ample, but such inspiration is exceptional, since it constitutes an effort that we cannot constantly repeat. On another hand, in such effort, the nose and mouth inhale conjointly. The fact must also be taken into account that, although in this effort or in yawning the mouth is opened to a maximum, the same is not the case in ordinary respiration, in which the mouth is only partly open and constitutes a narrow orifice, a transverse slit limited by the slightly parted upper and lower teeth.

An organic arrangement further explains the superiority of the nasal orifice. We know, in fact, that the two nasal fossæ are placed side by side and that their posterior orifice (which is wider than the anterior) debouches in a spacious cavity—the pharynx. The latter, from the standpoint of respiration, extends from the base of the cranium to the glottic orifice, through which the inspired air enters the chest. The accompanying diagram (Fig. 2) shows the general arrangement of these parts.

The air drawn in by thoracic dilatation passes through the nasal fossæ and enters the pharynx. Now, upon comparing the sections of the different orifices, we find that the air flows through the nasal conduits in a quantity nearly double that which is capable of passing in the same time through the glottis; whence we may conclude that such air undergoes in the pharyngeal cavity a certain compression designed to facilitate the entrance of the air into the chest. But this cavity is not inert, it possesses muscular walls which execute rhythmic motions synchronous with the respiratory ones and which were discovered twenty years ago by Garland, of Boston. These pharyngeal motions, the interpretation of which has remained obscure, seem merely designed to quicken the circulation of the air in the pharynx and to aid the thoracic effort.

It will be seen from this diagram that the pharyngeal apparatus is adapted to the nasal orifice and that the buccal orifice does not benefit by it. It is found, besides, that the nasal passage, in its entirety, proceeds by slight curves, while the buccal conduit is placed at right angles upon the glottis; and how prejudicial to the flow of a fluid an angular arrangement proves is well known. Let us add that the presence of the epiglottis constitutes also an obstacle to the buccal inspiratory current of air.

However, the preceding views, which are somewhat theoretical, required to be sanctioned by experiment.

In the first place, we may put before the reader's eyes an analysis of a series of respirations obtained by pneumographic inscription. The two tracings shown in Figs. 3 and 4 were furnished by the same subject, whose nose was nearly normal. The one to the left represents the nasal respiration of the subject (the mouth closed) and that to the right exhibits his exclusively buccal respiration (the nose obstructed).

These tracings were inscribed upon a disk having a uniform circular motion from right to left. Each respiration is figured by an angle with its apex directed toward the center. The inspiration is represented by the right side and the expiration by the left, when the apex of the angle is placed above. It will be distinctly seen that each angle is separated from the following one by a circular line, the time of repose at which the inscribing style remained immovable. The amplitude of every respiratory motion is shown by the absolute length of the tracing and its duration by the arc that it occupies.

It may be seen from an examination of these figures that the subject made in the same time a larger number of buccal than nasal inspirations—a proof that each of the former gave him less air. But we remark, too, that each of these less rich buccal inspirations is more ample and of shorter duration. We must conclude therefrom that in such cases the chest expands more widely for inhaling air, but that such amplification is of short duration, precisely on account of the effort that the subject has to make in order to expand his chest in breathing through the mouth. The upshot is that to such thoracic effort, the duration of which is short, corresponds only the introduction of a relatively small quantity of air.

Another proof of our opinion is furnished by our rhinometer, an apparatus by means of which it is possible to determine with precision the degree of the nasal respiration of a subject. We have here one of the most useful of determinations in practice, since a normal nose is rare in man, and, in order clearly to appreciate the degree of permeability of this organ, one has been content up to the present with a simple inspection. The rhinometer consists essentially of a receptacle, R, the capacity of which is known. A variable quantity of water may be introduced into this receptacle in order to diminish its capacity for air. A water level permits of knowing the quantity of water introduced. A sulphuric acid pressure gage is adapted to the receptacle, with which it is connected by a rubber tube. Three other tubes (the central one of which is provided with a mouthpiece and the two others with nosepieces) open in the apparatus.

The rhinometric test consists in causing the subject to make two inspirations—one through the mouth, with the nose closed, and the other through the two nostrils, with the mouth closed. The tubes not employed being closed, each inspiration produces in the receptacle a vacuum, the degree of which is shown by the displacement of the pressure gage column. Upon applying Mariotte's law, it is possible, through the change of pressure, to ascertain the volume of air inhaled at each inspiration. More simply, the pressure gage degree gives us the value of each orifice. To us, the nasal value of a subject is represented by the formula

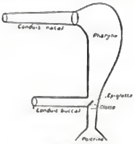


FIG. 2.

$$\frac{N}{B}$$

where N is the value of the nasal orifice and B that of the buccal. We have adopted the value B for unity because the buccal conformation is invariable, while the configuration of the nasal fossæ is rarely normal.

But, in order that the two different inspirations may be comparable, it is necessary (a) that they shall be effected with the same thoracic effort, and (b) that they shall be of equal duration.

In order to fulfill the first condition, we recommend to the subject to inspire with his maximum effort. We have thus greater chances of obtaining two efforts that are sensibly equal. The second condition is obtained through a special arrangement.

The apparatus, A, the details of which are represented in the corner of Fig. 1, consists of three electromagnets provided with hammers designed to flatten the three rubber tubes, and which are actuated by the clockwork, H, the operation of which is as follows:

Upon an ebonite disk having a uniform circular motion are fixed three concentric metallic circles interrupted according to unequal arcs. A contact, D, may be adapted to any one of these three circles, the interruptions of which are so calculated as to represent one second, half a second and three-quarters of a second. While the disk is in motion and the contact is touching the metallic circle, the current passes, the electromagnet operates, the tube is flattened and inspiration becomes impossible. When the contact touches the interruption, the current no longer passes, the tube opens, and inspiration is possible, but in a time accurately calculated.

A commutator, C, permits of causing the operation either of the middle electromagnet alone on the buccal inspiration or the two lateral electromagnets simultaneously in the binasal inspiration.

Finally, a second contact, E, in relation with the circumference of the disk, actuates, through wires, F and F', an alarm that warns the subject that he must inspire. This system produces three light bell strokes a quarter of a second before the opening of the tube. With a little practice, the subject makes the beginning of his inspiration coincide with the opening of the tube.

FIG. 1.—DR. MENDEL'S RHINOMETER.


FIG. 3.


FIG. 4.

FIG. 3.—Tracing of Nasal Inspiration (duration of the rotation of the disk, 26 seconds). I, inspiration; E, expiration; R, rest. FIG. 4.—Tracing of Buccal Inspiration (duration of the rotation of the disk, 26 seconds).

With this apparatus we have been able to determine the nasal value of a large number of subjects. There are very few that have reached 1·25, which seems to us to be the normal value (the buccal orifice standing for 1). Such value often oscillates around 1, on account of the frequent diseases of the nasal fossæ, the result of which is to diminish the permeability of the nose and thus to limit the consumption of oxygen by the individual.—Dr. Mendel, in La Nature.

* Physiologie et Pathologie de la Respiration nasale, par Dr. Mendel, 1897.

Non-Corroding Soldering Fluid.—The Iron and Coal Trades Review states that a reliable soldering fluid, free from rusting properties, may be made with four pounds of hydrochloric acid and about four pounds of ordinary zinc cuttings; if old zinc is used, a rather larger quantity will be required. It is best to add the zinc in two or three lots. When the acid is saturated—

that is, when no more zinc can be dissolved—add a small quantity of oxide to color and filter through ordinary muslin. Having filtered, add one pound of strong liquid ammonia, stir and then bottle. This preparation can be used as a soldering fluid and will not cause rust to appear on the articles on which it is used.

AN ANCIENT GREEK HEALTH RESORT.

The ancient Greeks, at all events after heroic times, were not always in the aggravatingly robust state of health that is the popular idea of their condition. Human nature is very much the same all the world over and at all times. There were many health resorts where sufferers were treated by Asklepios himself, or more frequently by his qualified assistants, i. e., the priests, and the modus operandi at these institutions formed the subject of a very interesting lecture by Miss J. E. Harrison, recently delivered before the University Extension Society, says the London Lancet. The lecturer gave an account of what was perhaps the earliest known medical school, namely, that of the centaur Chiron. Here the children of the heroes were taught simple surgery, riding, gymnastics, the rudiments of music, and, in common with the ancient Persians, to speak the truth, the last being a branch of education which has fallen into disuse among both nations. The chief subject of the lecture was, however, the shrine at Epidauros, which has recently been excavated and is in fairly perfect condition. The temple and the long corridors where the patients slept are all there, but the holy well alluded to in many inscriptions has not been found. Besides these the patients have left memorials of their cures carved upon stones, a very full one being that of a Roman gentleman, and we are able, through the courtesy of Miss Harrison in supplying us with the original Greek, to append a translation. "I, Marcus Julius Apellas, of Idrias and Mylasa, was summoned by the god, as I suffered from a variety of complaints, and especially dyspepsia; and as I was on my way through Aegina he ordered me not to worry so much about myself (μὴ πολλὰ ὀργίζεσθαι). When I arrived at the shrine, he told me to go about for two days with my head covered up, and these two days it rained. He also prescribed for me cheese and bread with celery and lettuce, to wash myself by myself—i. e., without the help of the shampooer—to drink lemonade made from citrons, to go to the fountains in the baths and rub myself against the wall, to run and do gymnastics, to walk in the portico, and to exercise on the trapeze, to rub myself in the sand and go barefoot. Also before I went into the bath I was to pour some wine into the warm water; I was to shampoo myself, but all the same I had to give an attic to the bath man. I was to sacrifice to Asklepios, Epione and the Eleusinian goddesses, and to drink milk mixed with honey. And one day when I was drinking milk alone he said, 'Put honey in your milk and you will get the bowels open.' And when I implored the god to make me well quickly so that I could get home, I had a vision in which he ordered me to rub my body all over with mustard and salt, and I seemed to go down to the springs by the shrine, and a boy went before me with a smoking censer, and the priest said to me, 'Now you are well and you must pay your fees.' So I did as the vision directed, and when I rubbed in the mustard and salt it hurt, but when I washed it off it did not hurt any more, and this happened on the ninth day after I came, and he touched me on the right hand and on the breast. And the day after, as I was sacrificing, the flame leaped up and burnt my hand so that a blister came up, but my hand soon got well. And as I stayed on there he told me that anise and oil were good for a headache. I had no headache then, but some time afterward when I had been studying I had a headache, and I used the anise and oil and the headache disappeared. He also told me to gargle my uvula with cold water (for I had consulted him on this point too), and the same treatment for the tonsils. And he told me to write all these matters down, and so, grateful and restored to health, I went away." The naiveté of this narrative is delightful, but the treatment is eminently practical. Apellas is very like the ordinary patient—the sort, we mean, who, having paid his fee, says, "Oh, by the bye, there's one thing more I want to ask you. I often have," etc.

THE LIGHT OF FIREFLIES.

In experiments on the properties of the light of fireflies, Prof. H. Muraoka used plates of copper, aluminum, zinc, and brass of equal size, separated from the photographic plates on which they were severally laid by a layer of cardboard having a cross shaped piece cut out of the center; wrapped the whole with three or four thicknesses of black paper, and exposed the bundle to the light of several hundred fireflies. His purpose, says The Popular Science Monthly, was to learn whether the light from the insects after filtration through the black paper could penetrate the metals and affect the photographic plate, and to determine the relative transparency of the substances used. To his surprise, the parts of the photographic plate under the cardboard were most darkened, while those under the cross shaped holes remained clear. The light of the insects seemed to behave very much like ordinary light, but, after "filtration," acquired properties similar to those of the Roentgen or the Becquerel fluorescent rays—properties apparently resulting from the filtration. Further, the filtered rays appeared to exert a peculiar action toward the cardboard—called by the author a suction phenomenon—similar to that of the lines of magnetic force upon iron. The properties of the filtered rays seemed to depend on the filtering substances, probably upon their thickness. They exhibited properties of reflection, but those of refraction, interference and polarization were not observed, although the author believes that they exist. Their properties, generally, appear to be between those of the ultraviolet and the Roentgen rays. The insects used in the experiments had two or three rows of luminous spots on their under-body; but the photographic plates were affected by the whole body as well as by the luminous spots, so that a complete image of the insect was formed when it was put upon the plate, the figure of the luminous part being, however, plainer than the rest.

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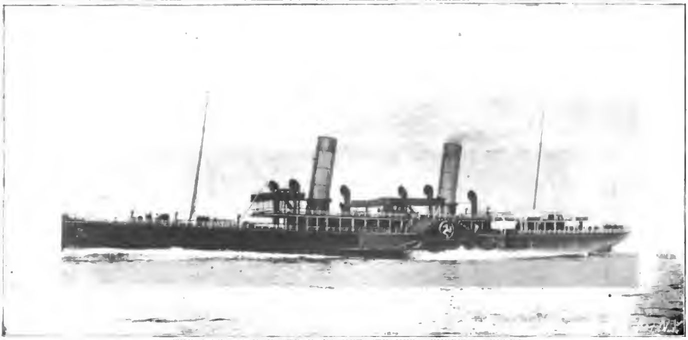
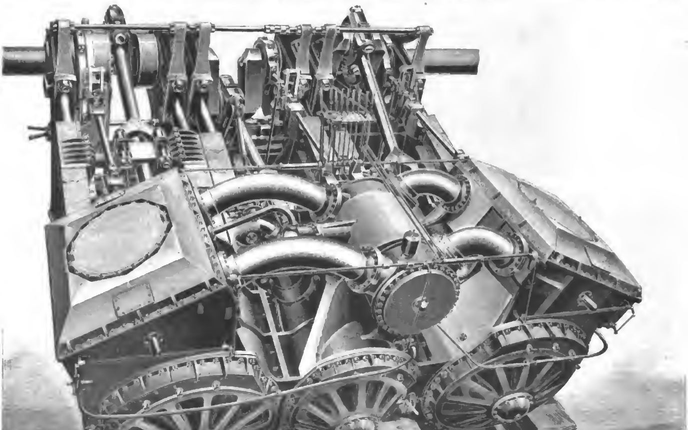


THE ISLE OF MAN STEAM PACKET STEAMER "EMPRESS QUEEN."



COMPOUND DIAGONAL ENGINES, STEAMER "EMPRESS QUEEN."

THE LARGEST AND FASTEST PADDLE STEAMER IN GREAT BRITAIN.

By A. J. SINCLAIR.

WE present engravings—an exterior and an interior view—of the new steel paddle steamer "Empress Queen," which is the largest and fastest paddle steamer in Great Britain and which has just recently been completed by the Fairfield Shipbuilding and Engineering Company, Govan, near Glasgow, to the order of the Isle of Man Steam Packet Company, Limited, Douglas, Isle of Man, for their passenger and mail service between Liverpool and Douglas (a distance of 70 nautical miles). The first vessel owned by the Isle of Man Steam Packet Company, which have now a fleet of a dozen steamers—8 paddle and 4 twin screw steamers—was built in 1830. It was of 116 tons burden and 200 indicated horse power.

It was through the kind offices of Lord Henniker (Governor of the Isle of Man) that the Steam Packet Company secured the consent of Her Majesty Queen Victoria to have the ship called after her own name. The principal dimensions of the "Empress Queen" are: Length over all 375 feet, breadth of hull 42 feet, breadth over paddle boxes 83 feet 6 inches, and moulded depth is 25½ feet. She is constructed of steel throughout and is of 2,500 gross tons. The hull is divided into several watertight compartments by means of steel transverse bulkheads, which, besides reducing the risk of foundering to a minimum, materially augment the strength of the structure, forming valuable supports and ties between the decks and framing. The decks are four in number, and are termed "lower," "main," "spar," and "promenade." The dining saloon on the lower deck accommodates 124 first class passengers, and is the handsomest saloon of its kind of any Channel steamer afloat. Ample accommodation is provided for the number stated to dine at one time, and in addition to the long tables running along the full length of the room, there are several small tables at which parties can dine. The ceiling of the saloon is in white and gold. Forward of this are the pantry, scullery and plate room.

MAIN SALOON, LOOKING FORWARD.

The pantry is furnished with all the latest appliances, including steam, hot water boiler and steam carving tables.

Another good feature is the fact that there is a saloon galley connected with the saloon pantry, where everything may be sent down without carrying the edibles through the saloon, as in the older boats. The first class smoke-room is large and agreeably arranged, the framing being in oak, the paneling in teak, and the upholstering in dark green morocco, while white and gold are the prevailing colors of the ceiling. The main saloon, which we illustrate, is paneled in mahogany, inlaid with satinwood and ebony, while the ceiling is chastely decorated in white and gold. All the upholstering is done in the finest moquette velvet, while the carpets are of the best Axminster, and form a beautiful contrast in shade with the cushions. The saloon is provided with couches, writing tables, etc., which go to make it as comfortable and complete as the most fastidious members of the travelling public could desire. To the right of the main saloon is the ladies' special saloon, which is unique in form and decoration, the latter being in satinwood, and set off in cozy alcoves by means of carved and arched columns in the same kind of wood. It is upholstered in an electric blue shade of velvet, with Axminster carpets to match. Leaving the main saloon, a descent is made by a handsome staircase to the second general saloon, which is fitted up with mahogany and satinwood panels, and upholstered in a light shade of moquette velvet, with carpets to match.

The forward part of the ship is allotted to the second class passengers. The dining saloon, forward of the machinery space on the lower deck, having bar and pantry adjoining, provides ample room for the second class passengers. On the same deck, and forward of this, is a ladies' second class saloon, supplied with every up-to-date requisite.

On the main deck above is arranged a second class shelter, which contains a bar, buffet, mail and parcel rooms. The gentlemen's sanitary appointments are of the most modern system, and are provided for first and second passengers, abaft and forward of the sponsons respectively.

On the spar deck aft, in houses, are six handsome private cabins, fitted with berths, etc., and amidships on the same deck is a cloak room, and combined bar and smoking room, while all fore and aft all available space is utilized for sitting room, there being sparred seats sufficient to seat over 600 persons.

Above this is a very spacious promenade deck extending from the fore end of the boiler room aft to the end of the first class cabin, with buoyant seats running the entire length, excepting a small portion at the after end, which is appropriated for the stowage of boats, a feature which has received special attention, so as to allow of the immediate launch of the boats if necessary.

The bridges (36 feet above the water line) that surmount the promenade deck are placed one at the foremost extremity for navigating purposes, and the other between the funnels, and extending from sponson to sponson, with captain's house under, for the better handling while docking and taking piers. From both of these bridges the bow and stern rudders are controlled by means of wheels connected with independent steam-steering gear placed below on the engine starting platform. A hand-screw steering apparatus is also placed in reserve aft in case of emergency. Docking and engine telegraphs are provided on each of the bridges. The vessel was engined by the builders.

For our engraving of the engines and for the following particulars we are indebted to London Engineer.

The "Empress Queen" is fitted with the largest and most powerful paddle engines yet built. These are of the compound diagonal surfacing condensing type, with three cylinders, viz., a high pressure cylinder in the middle and a low pressure cylinder on each side of it. The high pressure cylinder is 68 in. in diameter, and each of the low pressure cylinders is 92 in. in diameter, the length of stroke being 84 in. The lagging casing was not in place on the cylinder covers when the engines were photographed. The high pressure cylinder is fitted with a piston valve, the low pressure cylinders with flat slide valves, all controlled by the usual double eccentric link motion valve gear. The starting and reversing of the engines is effected by a large steam and hydraulic engine on the direct acting principle. The crankshaft, a ponderous piece of machinery, is built up, and, together with the paddle shafts, is forged of mild steel and bored hollow. The paddle wheels are of large dimensions, each having three sets of arms. The wheels are of steel and constructed on the feathering principle, with curved steel floats. Placed athwartships, between the cylinders and the supports for the shafting, is the condenser, which is of cylindrical form, the condensing water being supplied by a separate centrifugal circulating pump worked by an independent steam engine, which pump is also arranged so as to clear the bilges of water in case of a serious leak. The feed pumps, two in number, made by Messrs. Weir, of Glasgow, are also independent of the main engines, and are each capable of supplying the boilers with water when working at full power.

Steam is supplied from four double-ended boilers, arranged in two compartments, one forward and one aft of the engine room, with two funnels. The boilers are of the multitubular return tube marine type, having eight corrugated furnaces in each, and constructed entirely of steel, to stand a working pressure of 140 lb. per square inch and fulfill the requirements of Lloyd's and the Board of Trade. They are adapted to work with Messrs. Howden's system of forced draught and the necessary fans and engines are fitted to supply heated air to the furnaces. The engines indicate about 10,000 horse power.

The condenser is cylindrical, and placed athwartships between the cylinders and the supports for the shafting, and the condensing water is supplied by a circulating pump worked by an independent steam engine.

The paddle wheels are made of steel, and constructed on the feathering principle, with curved floats. The floats are each 18 feet in length. Steam is supplied to the engine by four double-ended boilers arranged in two compartments, one forward and one aft of the engine room. They are adapted to work with Messrs. Howden's system of forced draught.

The vessel has two funnels and two pole masts, and presents a very handsome and majestic appearance.

On July 8, the "Empress Queen" made four trial runs between the Cloch and Cumbrae Lights, when she averaged over 22 knots per hour, and, considering the stormy weather which prevailed on that day, the result was gratifying. The following Monday a six hours' sea trial was carried out on the Clyde with equal success, the average speed over the whole course out to sea being 22 knots. While on her trials on the Clyde the highest speed attained was fractionally less than 23 knots an hour.

The "Empress Queen," which is licensed to carry 1,994 first and second class passengers by the Board of Trade, is now running to and from Liverpool and Douglas, which will be her regular station.

REVOLVING BULKHEAD DOOR.

A DOOR for watertight bulkheads has now been introduced and put to practical use by Mr. William Kirkaldy, of Glasgow. It has been fitted into the new channel steamer Duchess of Devonshire, and has received the approval of the Board of Trade. There can be no doubt that this supplies a desideratum for steamers with safety bulkheads. It consists of a hollow cylindrical casing which is bolted to the bulkhead, one-half of the cylinder being in one compartment and the other half in the compartment adjoining. The casing has a doorway into each compartment. Within the casing is a close fitting hollow cylinder which easily revolves, and having one doorway of a size corresponding to the doorways in the casing. This inner cylinder is suspended by a central bolt overhead, and revolves freely on ball bearings. When it is intended to pass through the bulkhead, the opening in revolving cylinder is brought round to correspond with the doorway in the casing. The person enters and turns the cylinder until the opening corresponds with doorway on the other side. And thus the doorway by which entrance was obtained to the casing is absolutely closed before the cylinder is so far revolved as to give egress from the door on the other side. The casing is bored like an ordinary engine cylinder, and the inside cylinder turned to fit it accurately. It is evident that this door cannot be left open at any time, for one opening must be absolutely closed before the other is opened. The only point in its construction that we are doubtful about is the tightness of the inner cylinder around the casing. If it is made to fit as perfectly as to be watertight, or nearly so, it will not be easily made to revolve, and a loose or easy fit will not serve. We think some arrange-

ment for insuring absolute watertightness, without involving much friction, would be desirable, and would not be difficult to devise.

We are indebted to The London Engineer for the above particulars.

ROPE TRANSMISSION.*

Leaving out of consideration the use of wire rope, which has a limited application, there are two general ways of transmitting power by rope, usually known as the "English system" and the "American system." It is the purpose of this paper to refer only briefly to the former, and treat more particularly of the American system, which is practically a development of the last ten years, and is gaining in favor and use daily, not only in this country, but also abroad.

The English system, probably so known from its extensive employment in the mills and factories of England, has been in familiar use for a great many years. It has been by no means confined to England, and there are many notable drives of the kind in this country, particularly in New England mills and in street railway power houses. The driving and driven pulleys are grooved and the power is transmitted by as many independent endless ropes as may be necessary. The weight of the ropes is depended upon to give the necessary adhesion in the grooves, just as in the case of wire rope transmission; but these are made V shaped and of such size that the rope does not touch the bottom, but gets a very much increased frictional adhesion from the tendency to wedge in the grooves. Almost

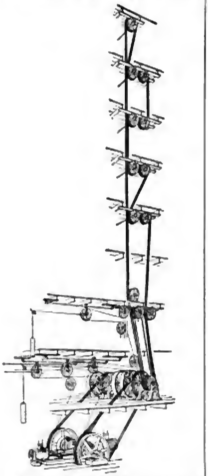


Fig. 1.—ROPE TRANSMISSION—ALL THE STRANDS OF THE DRIVE WRAPPED SUCCESSIVELY AROUND EACH DRIVEN SHEAVE.

universal practice seems to have adopted the angle of 45° for the sides of the groove as giving a sufficient grip for practical purposes, without undue tendency to squeeze the rope out of shape. It is a mistaken notion that many people seem to have that there is a loss of power in pulling the ropes out of the grooves as they leave the sheaves. With 45° or with even a sharper angle, there is no appreciable disposition on the part of the ropes to stick in the grooves and follow the sheaves.

The English or separate rope system has certain disadvantages which are largely overcome in the American plan. Owing to the practical impossibility of getting all the ropes of precisely the same length, some of them are always doing more than their proper share of the work. This tends to stretch them and reduce their diameter, causes a differential action and slipping, all of which operates to wear out the ropes. Various devices have been tried to equalize the strain on the ropes, one of the simplest being the use of grooves having slightly curved instead of straight sides. This makes the angle of the groove different at every point and equalizes the grip of the ropes which lie higher or lower in the groove, according to their variations in diameter. In designing drives by this system a liberal allowance has to be made for the certainty that the power is not going to be uniformly borne by the ropes; that is, some of them will be doing more than their proportion of the work; and, furthermore, that each rope is weakened by a splice. This places the separate rope system at a disadvantage in the matter of first cost of the installation. While the splice is not of necessity a cause of trouble, it is more liable to give trouble than any other part of a transmission, and the multiplication of them in this system is not a desirable feature. The American system, for all practical purposes, overcomes the difficulties cited above. One continuous rope is employed, wound spirally back and forth, around driving and driven sheaves as many times as necessary, one of the wraps in its course being taken around a tension carriage or tightener. The driven sheaves may be several in number and variously located with reference to the driver, as shown in Figs. 1 and 2. In the former, power is distributed to several points by wrapping all the strands of the drive successively around each driven sheave. In the latter one or more strands, as may be needed for the required power, are used at each point. This plan requires less rope and fewer bends in it, but the amount of power that may be utilized at each point is limited; while in the former plan it may be varied at will. The tension carriage is automatic in its action, and is to the system what the governor is to an engine. It insures a uniform amount of work being performed by each wrap of the rope, and is properly weighted to give the desired driving force and to take care of the variations in length, due to changes in temperature, moisture, etc.

The sheaves used in this system are grooved similarly to those previously referred to, the general angle being 45°. As a matter of practice, it will be observed that these are far from being so deep as in the English system; that is, the ridges between the grooves ordinarily

Fig. 2.—ROPE TRANSMISSION—ONE OR MORE STRANDS, AS NEEDED, USED AT EACH POINT.

project but a little above the pitch line or line of contact with the rope, instead of coming some little distance beyond or outside the ropes. This may be noteworthy as bearing silent testimony to which system operates the more smoothly, as in a properly designed transmission there should be no need of a deep groove to keep the ropes from jumping out. It is of the utmost importance that all of the grooves in a sheave should be exactly alike and of the same exact circumference; otherwise there will be a differential action set up between the ropes. Manufacturers who make a specialty of rope transmissions should have special gages and devices for calipering and measuring the circumference of the grooves to insure this accuracy, but it has been the writer's observation that this most important feature does not receive the attention it should. It has been emphasized by the unsatisfactory performance of wooden sheaves, where the impossibility of preventing the uneven wearing of the grooves has caused their abandonment, after they have done much to discredit the American system of rope transmission.

The diameters of the sheaves should always be as large as convenient; it is very poor economy to reduce the first cost of a drive by using small sheaves. Forty diameters of the rope should be the rule and thirty diameters the minimum size. It is well to observe as nearly as possible the same proportions for idlers. Even where they only carry the rope, it has to conform to their circumference for the moment it is upon them. This consideration is, perhaps, more theoretical than practical, and it may be better at times, where the spans are short, to make the idlers smaller to reduce their weight and insure their keeping up to the full speed of the rope. For this same reason they should have the V shaped groove. Round grooves in the rope bottoms are often used, but there is apt to be more or less slipping with these, especially in starting up, and consequent abrasion.

Various methods have been employed in the manufacture of sheaves, the object sought being to obtain perfectly true, uniform and smooth grooves, with the minimum machining, or without any at all. Wooden grooved sheaves have been used to a very considerable extent, and, as said, been discredited; casting the grooves in chills gave great promise, but was abandoned after a costly series of experiments; corrugated steel rims have been tried; and an excellent sheave has been made or "built up" of separate grooved rings bolted together, as many of the rings as necessary having arms and hubs, and being really complete single grooved sheaves. Fig. 3 shows two drives having this kind of sheaves, the driving and driven shafts in these drives being at right angles. This type of sheave is made in a special flask, with provision for ramming the sand very compactly in the grooves, the latter coming out of the sand so true and clean that they are merely smoothed a little with emery for a finish. The best and most economical sheaves made to-day are molded by particular machinery made for that purpose, and come from the foundry almost true and smooth enough to be used without machining, though a light cut is usually taken.

The tension carriage is a most important element of the drive. It should adjust itself automatically to the proper inclination. It is obvious that as the rope is wound spirally on the sheaves, it must be led back from the last groove of one of them to the first, otherwise it would run off the sheaves entirely. The tension carriage sheave is set at the proper inclination to accomplish this, as illustrated in the dynamo drive shown in Fig. 4. It must take care of all the minor inequalities and variations in the sheavs and rope, as well as provide the proper back pull for the required driving force, hence the carriage should be on good sized rollers, so as to be sensitive and immediate in its action. Sufficient travel should be provided for it to take up about one-fortieth of the length of the rope. This operation is often reversed, and I have frequently known tension carriages to be drawn up as far as possible by the shrinkage of the rope after a heavy rain or period of wet weather. The weight used should be only just enough to give the requisite driving force without slipping; any more than this only puts an unnecessary strain on the rope and shortens its life. The location of the tension carriage in the drive is as often determined by convenience as anything else. It may be horizontal, vertical or inclined. Two things must be kept in mind, however—it must be on one of the slack ropes, and if the particular slack rope cannot conveniently be taken from the driver directly around the tension sheave, but for convenience of location must be led around the driven or some other sheave, it must be taken around a loose groove, so that it may lead directly to the tension carriage without interference. I have frequently seen both of the above points wholly disregarded, both by manufacturers, who profess to make a specialty of rope transmissions, and by engineers of high standing.

The final element of transmission is the rope. In the

* A paper read before the Western Society of Engineers by Stanton B. Peck, Mem. Am. Soc. Mech. Engrs.

English system cotton ropes are generally used. This is probably from force of habit, as these drives were first introduced in textile mills, where cotton was a familiar article. It is, however, well adapted for drives of this kind, because it has comparatively little elasticity and does not stretch, hence it is easier to keep the ropes of uniform length than with hemp or manila. This rope is made somewhat peculiarly; it has four strands twisted together in the usual way, but each strand consists almost entirely of a bundle of yarn laid parallel with practically no twist. Each of these four bundles of yarn is wound spirally with some quite small bundles, which serve as binders and as a protection. This is what is known as the Lambeth brand of rope. It is very pliable and the friction of the soft cotton yarns on each other is less destructive than with manila; but the latter is much stronger than cotton and is almost universally used in the American system.

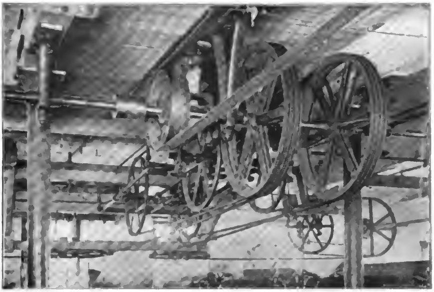


FIG. 3.—TWO DRIVES WITH BUILT UP SHEAVES.

Manila rope for the transmission of power should be made especially for that purpose. The twist should be looser than with ordinary ropes; only the longest and best fibers should be used and selected so as to be of uniform size for the same rope. These are laid up as the rope is made, in tallow, which acts as an internal lubricant and also protects the fiber from moisture. Graphite is sometimes used also in addition to the tallow, and assists in preventing internal chafing, but there is great difficulty in making the splice hold in such a rope. The best transmission rope, as shown by a series of tests, is made as above described, laid up in tallow merely and distinguished by a red yarn running through it. Up to one inch and a quarter three strands are used, and above that four. The four strand rope is the better shape, as being more nearly round, but in the smaller sizes the strands are so small that they do not make so good a splice. While not absolutely necessary, external dressings applied at intervals to the ropes are desirable, especially for outdoor drives, and where the rope is exposed to a hot, dry atmosphere. These dressings are made of varying proportions of such ingredients as tallow, graphite, pine tar, linseed oil, cottonseed oil, molasses, resin, etc. One very conveniently applied dressing is made in the form of sticks about 18 inches long and three inches in diameter, which are held against the rope while it is running.

Ropes of rawhide gave great promise a few years ago, and a number were put in use; most of these have been replaced with manila. Rawhide rope has great flexibility, and having comparatively few strands, is better able to stand internal and external friction, as there are no small yarns to chafe and break. Its most frequent use was for dynamo drives and where small sheaves were necessary. The great elasticity causes a good deal of whipping and slapping, and it is very difficult to make a splice hold; furthermore, the first cost is several times that of manila, and as it has not shown a proportionately greater durability to justify this, it is probable rawhide will never be used to any great extent.

As I said above, the splice is the weakest part of the drive. Correctly made, however, and in a properly designed drive, it should never give any trouble. As a matter of fact, much of the trouble caused by the failure of splices is due to the prevailing notion that any kind of a splice will answer. The ordinary sailor's splice, or the short splice, which is perfectly satisfactory for hauling or hoisting ropes, is quite inadequate for transmissions. The splices suitable for the latter are variously known as the English splice, or the long splice, and are from 80 to 150 diameters of the rope in length. Various mechanical splices have been tried, but most of them have had a very limited use. One objection to them is that they give way without warning, whereas the ordinary splice usually attracts attention by beginning to unstrand in ample time to prevent any damage.

Leaving the subject in its details and considering its general application, the availability for long transmissions, and especially for outdoor drives, is at once apparent. Fig. 5 illustrates a drive of this kind. By the use of rope the highest economy may be secured in large manufacturing and industrial establishments, as it becomes possible to distribute the power from one central power house. It is unnecessary before this society to dwell upon the desirability of such an arrangement as compared with the old way of having engines, and perhaps boilers, scattered all over a plant.

In Fig. 6 the engine is in the basement of building not shown, to left of the cut. The power is carried up through the roof, across the alley and down, where a portion is transmitted to a line shaft projecting through first building shown in cut, and the balance carried on to the building shown on the right.

In vertical drives, and in main drives from the fly-wheels of engines, it is well known that there is excessive journal friction from the tightness at which belts must be kept in the former case and from their great weight in the latter. Much of this is saved by the use of ropes, besides the advantage of a much quieter and smoother running drive. It is not at all uncommon to find fifteen or twenty per cent. of the power absorbed by journal friction and the stiffness of heavy main belts. A properly designed rope drive of the American system does not absorb more than four or five per cent. As it is not good practice to require a single tension carriage to take care of more than about eight or ten wraps of rope, these main drives are usually made up of two or more drives side by side exactly alike, each having its own rope and tension carriage. A plan sometimes employed is to wind the ropes in pairs, treating a pair of ropes precisely as though it were a single rope. Although there are some successful drives running in this way, this plan is not to be commended, as the two ropes on the tension carriage do not permit it to properly control either. An advantage of dividing main drives, as noted above, is that a portion of them may be run independently, or repaired while the balance of the drive is running.

In crossed, quarter-twist and mule stand drives, the flexibility of rope and the ease with which it may be led around the corners make a very appreciable saving of the large percentage of power that is wasted in overcoming the stiffness of belts under similar conditions.

Freedom from slipping makes rope particularly suited for dynamo drives for electric lighting, assuring a steadier current. I recall in this connection an incident where the basement of a large office building was partially flooded by continued heavy rains. Several of the dynamos were driven by belts, and were at once rendered inoperative, while those that were driven by ropes gave uninterrupted service.

The speed at which ropes are run with ranges from 1,000 to 5,000 ft. per minute. I have known of drives running successfully as high as 8,000 ft. Above 5,000 ft. a little figuring, using the ordinary formula, will show that centrifugal force, tending to throw the rope out of the grooves, becomes an important factor. Experience would seem to show, however, that practically it does not act as rapidly to diminish the driving force as it is theoretically supposed to. Its action can be counteracted by additional weight on the tension carriage, so that I have no doubt but what successful transmissions could be employed at a rope speed as high as 10,000 ft. per minute, or more, although the

FIG. 4.—TENSION CARRIAGE SHEAVE IN DYNAMO DRIVE.

FIG. 7.—METHOD OF CARRYING OUTDOOR DRIVE.

wear of the rope would be rapid. The best speeds are from 2,500 to 4,500 ft. per minute.

The use of winder sheaves is occasionally resorted to to give additional frictional adhesion, at both driving and driven ends of a transmission. That is, the rope in passing from driver to driven is wrapped one or more times as may be necessary around another sheave near the driver before being led around the driven, and wrapped around a similar sheave near the driven, before returning again to the driver. This is done in the drives in Fig. 3. It is a familiar device employed in all cable street railways. The advantage derived is not as great as might appear at first sight, as the tax upon the rope is greater from the frequent bending, and from the increased strain put upon the fewer number of ropes that transmit the power. This device may be used to advantage, however, in very long transmissions, as it reduces the amount of rope and the number of grooves to the carrying idlers; and also in drives where there is a great disparity in size between the driving and driven sheaves. I have in mind a successful transmission in an electric lighting station where the driving wheel is an engine flywheel 20 feet in diameter, and the driven sheave but a short distance away, 34 inches in diameter. The loss of arc of contact on the driven sheave is compensated by wrapping the rope four times around each of two rewinders at the driven end, giving the driven sheave practically 20 grooves to 12 in the driver. In drives of this kind care must be taken not to place the rewinder too near the sheave, as there may not be sufficient elasticity in the strands of rope to equalize the differential action set up by the unavoidable inequalities in the size of the rope and the grooves of the sheaves, and an excessive strain is produced on the shafts. The writer was once called upon to examine eight drives, about 300 ft. long each, where the power was transmitted by two $1\frac{1}{2}$" ropes and six wraps taken around a winder at each end of each drive. These winders were set so close to the main shaft that several of their shafts, which were $3\frac{1}{4}$" in diameter, were broken and all more or less badly sprung. A somewhat similar experience was met with by parties endeavoring to drive a street railway car by wrapping a continuous rope from sheave on central armature shaft six times around each axle and finally around a tension carriage. It was found that while the truck could be readily pushed by two men, with the ropes on it took about 40 H. P. to move it.

FIG. 5.—METHOD OF CARRYING OUTDOOR ROPE DRIVE.

FIG. 6.—ROPE DRIVE CROSSING ALLEY AND SERVING TWO BUILDINGS.

There are three questions that are constantly asked about rope transmissions: what powers will the various sizes of rope transmit at given speeds, how long will the rope last, and what is the cost relative to other modes of transmission? Unfortunately, a clean-cut, decisive answer cannot be given to any of them. There have been tables published giving the horse powers of different sizes of rope at various speeds, but none by any one who has had the experience that would make such a table reliable. Many things have to be taken into consideration in designing a transmission. Large sheaves and a few wraps of comparatively large ropes should be used in preference to small ropes and many wraps. Excessive speeds, reverse bends and frequent turns should be avoided as far as possible. In no small number of cases, however, the exigencies of the situation necessitate some one or more conditions that are unfavorable, and it is obvious that the work demanded of the rope should vary, as experience has shown the conditions to be more or less unfavorable. As an average illustration, however, of its transmitting power, it may be said that under ordinary conditions and at a speed of 2,500 feet per minute 1" rope will satisfactorily transmit 12 horse power, $1\frac{1}{2}$" rope 26 horse power, and 2" rope 48 horse power. It must always be borne in mind that the durability of the rope must be kept sight of as well as the actual transmitting power. This varies very greatly. Drives put in on the English system, using cotton ropes, are numerous where the ropes have lasted ten to twenty years. These drives, however, all have ropes two inches or more in size, and very large sheaves proportionately. It may be said that the average life of ropes of medium size is upward of five years. A great many that were put in more than five years ago are still giving good service to-day, so that as a matter of fact the system has hardly been in use long enough to determine what would be a fair length of service to expect. The small ropes, under unfavorable conditions, often have to be renewed annually. I know of one concern running a $\frac{3}{4}$" rope at high speed on a 9" sheave, who put on a new rope every three weeks, yet are perfectly satisfied with the transmission, which is the most successful means ever found to accomplish the purpose.

In the matter of comparative cost of rope and other transmissions, it can only be said that the grooved sheaves are considerably more expensive than plain pulleys, and there is the additional cost of the tension carriage; while, on the other hand, rope is very much cheaper than belting. From this it can be inferred that short drives of belts are the cheaper, while long drives of rope have the advantage in first cost, and increasingly so as the distance between centers increases. Again, with heavy main drives, from flywheels to jack shaft the large leather belts are so expensive that even with comparatively short centers the rope transmission is the cheaper.

I will only add in conclusion that rope transmission should be designed with intelligence and judgment based on experience. Where this is done they are certain to prove efficient and economical. The idea that because a rope is so flexible and so simple a thing it is bound to run all right, no matter what is done with it, is a mistaken one, and is largely responsible for any mistakes that may have been made or prejudices created against this most modern and satisfactory means of transmitting power.

THE VALUE OF MACHINERY AS AN INDUSTRIAL LEVER.

THE first meeting of the session of the South Staffordshire Institute of Iron and Steel Works Managers was held on October 16, at Dudley. Mr. J. W. Hall, president, occupied the chair and delivered an inaugural address. He said that the Victorian era had been essentially the era of applied science, and that its most remarkable feature had been the extraordinary advance made in the material well-being of the people, more especially in that of our laboring population, by the employment of machinery which had rendered possible the production and distribution of the necessities and most of the luxuries of life at prices so remarkably low, combined with the simultaneous payment to the workers of wages so much higher than the world had ever seen before. This advance indicated that their hope of material prosperity in the future lay in still further development along the same path. It could only be by offering for sale to the inhabitants of the world articles produced by mechanical means, at a price and of a quality which would induce them to purchase, and to do this they must increase by every possible means the efficiency of their tools, and of their men who employed them. Their competitors abroad fully realized this fact, and were doing all they could to increase their manufacturing powers; and in the race for manufacturing supremacy, they were aspiring to sell to England what England formerly sold to them. The introduction of some new labor saving device might press hardly on the individual, but its use always eventually raised the scale of living of the community which employed it. The trades in which wages were lowest were those in which machinery had not yet come to the relief of the worker. Let machinery be introduced, and the product of the worker was so much increased that the half civilized handicraftsman had no chance against him. The world could now afford to pay to the man who worked the machine much more for his services, and so he was certain eventually to get more for his day's work. In the South Staffordshire district they would find that those branches of the iron trade which were carried on in small shops, unaided by power, were badly paid, or had totally disappeared before the employment of machinery elsewhere. There were men to-day who, in spite of all previous experience, seriously proposed, as a means of increasing the comfort of the workers, to limit as much as possible the efficiency of the workman or the machine which he tended. They took up the argument that the smaller the proportion of the work of the world which a man did, the larger would be his share of the world's income; the less his output, the greater his pay; and they seemed seriously to expect that a man could enjoy the benefits of the products of machinery without using it. It could not be too emphatically stated that upon England maintaining her manufacturing trade depended the material prosperity of the whole population. Should there be any material reduction in it, the first to suffer, and suffer most acutely, would be the workman: but it could not be too often pointed out

that there was not an inhabitant of these islands, let his trade, occupation, or profession be what it might, but would find his income sensibly diminished were any serious falling off to occur to English industries for any appreciable period. Privileged or monopolized trade was no longer possible; the "goodwill" of a business, once a valuable asset, had now almost disappeared. To supply the best article at the lowest possible price was the one qualification for success in the markets of the world to-day.—Colliery Guardian.

THE DISPOSAL OF GARBAGE AND REFUSE.*

THE subject upon which your committee was requested to make a report concerns the collection and disposal of the solid waste matter in cities, such as garbage, ashes, manufacturing refuse, etc. This branch of municipal work had heretofore not received satisfactory attention. There was much diversity of opinion regarding the proper methods to be pursued, and a basis upon which safe judgment could be founded did not as yet appear to exist.

It was, of course, impracticable for your committee to make any original investigations or experiments to enable it to solve the questions before it. Its work had to be confined to the collection of statistics, the inspection of works and the weighing of the evidence, and opinions of those directly engaged in the actual work of garbage and refuse collection and disposal.

In order to gather the needed information, circulars containing numerous questions were prepared and sent to 170 cities of the United States and Canada. The existing literature of the day was examined and visits of inspection were made, as was convenient, to the most important and instructive works of both Europe and America. By classifying, comparing and critically studying the information thus obtained, it became practicable to throw some useful light on the subject and to enable your committee to reach conclusions.

This information had been practically all compiled last year, and such of the results as were then apparent were reported at the last annual meeting. It was added then that, in view of certain forthcoming reports on some very thorough experiments, being conducted in the cities of Hamburg and Berlin, your committee did not deem it proper to present its own final report until after this European information had been obtained. Not until within the last few weeks did the documents reach this country. Their value, in the opinion of your committee, justifies the delay in concluding its own work, as without embodying these European results the committee's report would have failed to record the most complete, instructive, and valuable experiments on garbage and refuse destruction for large cities that have yet been published.

The collection and disposal of garbage and refuse must be considered, first, from a sanitary, and secondly, from a financial aspect. Satisfaction must be given in both respects; otherwise, as previously reported, the result will not be successful. "There may be a disposal which is entirely proper in a sanitary way, yet the expense may be so great that the method precludes general adoption. On the other hand, some cheap method of disposal may not comply with sanitary requirements, and can also not be recommended."

The solution of the problem depends upon the character and composition of the matter to be dealt with, upon the quantity to be handled, upon the necessary transportation to the place of disposal, upon the character of organization in charge of the work, and upon the ultimate disposition to be made of the material.

The best method of disposal will vary according to what can or must be done with the material. When it contains matter that may be converted into useful products, its disposition might properly differ from that which is necessary when it must be destroyed in a manner to prevent a nuisance or injury to health. Such utilization, when practicable, must be secondary in importance to a proper sanitary disposition. If the cost of disposal can be reduced by converting a part of the whole of the material into salable products, then utilization may be advocated for financial reasons, but only with the provision that a sanitary danger or nuisance is not created.

The best method of disposal, when the quantity of material is small, may also be different from when it is large; it will also depend upon whether it must be transported to a great distance or can be disposed of near the point where it is collected.

The questions of collection and disposal are, therefore, somewhat complex. From the variety of conditions which may govern the case, it will be seen that proper answers can only be given when the special conditions existing in each city or town are known. In the opinion of your committee, no single system of disposal can be recommended as being the best under all conditions.

This conclusion is further supported by the fact that the character of city refuse as collected differs materially in different countries, cities, and even in different parts of the same city. In some communities all refuse, namely, kitchen garbage, ashes and dry refuse from houses, factories, wharves, etc., is put into the same receptacles and delivered at the same point. In others, a separation is maintained of some of the materials, the food waste being collected in a different way and at different times from the dry refuse and ashes. In cities or parts of cities where no sewerage system exists, the night soil or human excrement is collected in special receptacles, and is disposed of sometimes separately, sometimes together with other refuse matter.

The terms garbage and refuse were defined by the committee as follows: By garbage is meant animal and vegetable waste matter subject to rapid decay, and collected from kitchens, markets, slaughter houses, etc., but not including night soil or street sweepings. By refuse is meant the miscellaneous material, comprising the dry waste matter from houses, stores, factories and streets, such as ashes, paper, straw, wood, rubbish, etc. These definitions are most commonly used throughout the country. In the Southern States, however, the term "garbage" is sometimes applied to dry refuse (Atlanta, Ga.) and to a mixture of dry refuse with animal and vegetable waste. In New England the word "swill" is more commonly used to designate kitchen waste, while in Pennsylvania and one or two other States "slop" is the name applied to it.

The present final report to a certain extent supplements the previous reports, but it contains all the conclusions which have heretofore been stated. The appendix contains the replies to circulars from over 150 American and Canadian cities, which constitutes a valuable mass of information concerning the status of the question in this country. It also contains descriptions of the most important methods of disposal in detail and of receptacles, carts, wagons, etc., which appear to have given fair satisfaction. It finally contains descriptions of the best European practice and the results thereof.

COLLECTION AND REMOVAL TO PLACE OF DISPOSAL.

The committee has found that in comparatively few places was there a careful and wise consideration given to the character of utensils, receptacles, carts or wagons, in which the refuse and garbage is collected. In most cases these articles are left to the judgment of house occupants or of contractors who collect the material.

No general recommendations can be given with reference to the character of the receptacles and wagons, because they should vary according to local conditions, and with the climate and method of final disposal. In cold countries, for instance, metal receptacles are not advantageous in the winter months, and wooden receptacles are preferred. The reverse is the case in hot climates. In all cases, however, they should be covered with a lid, and where cities give any directions at all with reference to these receptacles, this requirement is usually stated. Suitable cans for different conditions are described in the appendix.

Carts or wagons should be made of special design to suit the special conditions. Whether the garbage and refuse are collected in the same carts and wagons, or whether there is a separate collection, these carts and wagons should be covered. They should be covered with lids that can be easily opened and also firmly closed. They should be constructed of such shape that they can be easily and completely emptied of all their contents. Good designs for this purpose are found in use in some of our cities and are given in the appendix. It may be found economical, with certain cases of disposal, to have the carts so constructed that the boxes may be lifted off the wheels for dumping purposes. In some cases it may be preferable and less expensive to collect the material in large wagons drawn by two horses, while in other cases carts with single horses may be preferred. With the variety of designs that are in use, an intelligent selection of the most suitable design for given cases may be easily made.

Where the garbage is disposed of by dumping at sea, special scows and boats have been constructed for the purpose. The experience in Boston and New York City with such boats has probably developed the most suitable apparatus of this kind. The boats are so constructed that they can not only be readily loaded, but also can discharge the material by a single operation.

The collection of night soil from sections of the city not having sewers is usually accomplished by apparatus known as odorless excavators, and of these also there are several designs in the market which have proved satisfactory. The important features being an air-tight vessel, means of introducing the night soil by pumping through a special hose, and attachments for preventing the escape of noxious gases.

Regarding the frequency of collecting garbage and refuse, there seems to be no uniformity of practice, even in cities similarly situated. In some cases garbage proper is collected daily during the summer months; in most cases, however, but two or three times a week. Often the collection is more frequent in the densely populated portions than in the suburban districts of the city. It is the opinion of your committee that no difference should be made with reference to the density of population. Readily decomposing material should be removed as soon as possible after it has been offered for collection, as it will become odorous and objectionable equally as soon in the suburbs as in the center of the city. Decomposition is a question of time, not of locality. The frequency of collection should therefore depend on the season. It should, if possible, be collected daily in hot weather, at least three times a week in the spring and fall, and not less than twice a week in cold weather.

Ashes and dry refuse may be collected at all times once a week without objection, this being the usual practice. Refuse from business establishments or hotels must, in some cases, be removed more frequently on account of its rapid accumulation.

If garbage is collected daily, no decomposition should take place. Where it is collected less often in warm weather it is recommended that the receptacles, carts, wagons, etc., be disinfected and, if practicable, washed every time after they have been used. When garbage and dry refuse are removed together, the frequency of collection should be the same as though it were all garbage.

CHARACTER AND COMPOSITION.

Your committee has been able to secure but little information on the composition of garbage and refuse in the United States. In English and German cities this material has been frequently analyzed. In this country we have only secured one satisfactory statement, namely, from New York City. The analyses are given in the appendix.

The combined garbage and refuse in Germany differs from that in England by being poorer in combustible matter. English refuse contains more unburnt coal and also more waste organic matter. For this reason the products of combustion weigh but one-third of the original weight in England, and about one-half of the original weight in Germany.

In America, so far as ocular inspection goes, the ashes contain fully as much unburnt coal as in England, and decidedly more than in Germany. The quantity of kitchen garbage and combustible refuse is greater per inhabitant in America than in England, and still greater than in Germany. While the amount of organic matter in American garbage is greater, it is also true that in most cities it contains more moisture. The large quantity of vegetable and fruit refuse in our country probably causes this result.

American kitchen garbage contains from 2 to 4 per cent. of grease. European garbage contains somewhat less, i. e., from 1 to 3 per cent. From kitchen garbage about 5 per cent. of the original weight is left as ashes after combustion. When American garbage and dry refuse, including ashes, are mixed and burned, about one-fourth of the weight of the original mass remains as clinkers and ashes; in England one-third and in Germany one-half. It is therefore seen that three-fourths of the American mixed garbage, two-thirds of the English and only one-half of the German mixed garbage can be burned.

FINAL DISPOSAL.

The various ways in which garbage and refuse have been finally disposed of in American cities were mentioned in previous reports, and a few conclusions have already been drawn. In reviewing the subject, and with the recent evidence, particularly the above mentioned European reports before it, your committee can complete and sum up its conclusions as follows:

It has already been said that different conditions require different solutions. In view of this fact, a distinction must first be made as to whether the garbage is to be disposed of by individuals or by the community at large.

(A.) By Individuals.—If each householder must himself dispose of the garbage and refuse, as in the case of a country house or in a village, the following is recommended:

There appears to be no way in which this material can be properly and cheaply disposed of when the garbage is mixed with ashes and other refuse, and it is the opinion that in such cases it should be kept separated. There are several ways in which the most objectionable part, namely, the garbage, can be safely and properly disposed of. When it is fresh, and when nothing of a poisonous nature is added, then it can be safely fed to animals. In country houses this method is common. It is necessary, of course, that such feeding be confined to cases where proper intelligence can be exercised. The garbage from hotels is also very commonly sold for feeding, as it is profitable, and with proper care no objectionable results need follow. Where this method is not applicable, or where dangerous results are feared, there are but two other methods which your committee can indorse, namely, cremation and burial. To burn the garbage in the kitchen stove by throwing it upon the coals is often practiced, but is objectionable on account of the offensive odors which arise therefrom. Within a few years means have been provided and are in the market for carbonizing the garbage in the flue leading from the kitchen stove. This process, where applicable, can be well recommended. The garbage is slowly dried, then charred, and finally can be used for fuel, all without the discharge of any odors. Where this carbonizing is not undertaken, the only other safe alternative is a burial of the fresh garbage.

The remaining refuse of a country house consists of ashes, dry rubbish and perhaps also of night soil. In this case the latter is often converted on the premises into compost or manure and used upon the surrounding grounds. There can be no objection to such a method of disposal, if in case of certain sickness the night soil has been thoroughly disinfected. The disposal of ashes and rubbish will furnish no difficulties in the present case, as they can be dumped at an unobjectionable point on the premises or elsewhere.

(B.) By Communities.—The problem becomes a very different one when garbage and refuse must be collected from many buildings as in cities, and a common disposal provided. The quantities to be dealt with become large, and the control over the character of the material is lost. Other methods of disposal must, therefore, be resorted to, if sanitary as well as economical results are to be obtained.

In this case it becomes practicable either to combine all the various rejected materials or to keep them separated. A choice between the two methods will depend upon the local conditions and customs. In many cities, in nearly every European city, the garbage and dry refuse, including ashes, are all mixed, removed and disposed of together. In American cities they are combined in some cases and in others a separation of some of the material is made. Your committee is not able to state that either one or the other method is to be preferred in all cases. There may be instances where a separation is better and there may be others where the combined removal offers less difficulties and is less expensive.

(a) Separate Removal.—The fact that domestic garbage contains a fair percentage of grease, and that the remaining material may be converted into a fertilizer, has caused the development of processes in this country for converting garbage into these two materials to be sold at a profit. Such a method of disposal is applicable only in large cities. The works, which must be erected for this treatment of garbage, can only be profitable if large quantities are handled. Such works have been erected in a number of cities in the United States. Companies were formed, and the work was undertaken with the expectation of conducting a very profitable business. Experience has demonstrated, however, that in many instances there was no profit, and in others that it was small. It has heretofore been found impracticable to conduct the works so that a nuisance would be wholly prevented, and it was, therefore, found best to locate them at points where an occasional nuisance would not be objectionable. After several years operation a number of these works have been abandoned because, under the necessary sanitary restrictions, they were found not to be remunerative.

From a sanitary point of view, or as regards the creation of a nuisance, this process of disposing of garbage should be viewed with some suspicion. It should be allowed and, in the opinion of your committee, is only justifiable when the works are so located that a nuisance cannot possibly be created, and when it is also found to be cheaper to the community than cremation.

Experience has shown that in many cases this reduction process does not dispose of all the offensive material, and that it must be operated in conjunction with the cremation process, because some of the material collected with the garbage will neither yield grease nor make a good fertilizer, and is best disposed of by burning.

The latest and largest works for disposing of garbage by the reduction process have been built on Barren Island, where the garbage of New York and Brooklyn

* Report of the Committee of the American Public Health Association on the disposal of garbage and refuse, Rudolph Hering, M. Am. Soc. C. E., Chairman, at the annual meeting of the Association at Philadelphia, October 26, 1897.

is being treated. Contracts for this treatment were made within the last year or two, and it appears at the present time that the history of these works may possibly not differ much from the history of others. In this case, however, the distance from inhabited sections and the great quantities of material to be handled offer more favorable conditions for success than in most other cities. As the selling price of both the grease and the fertilizing residue has been steadily declining, it may probably be safely inferred that the profit of the reduction business does not meet the early expectations.

When the garbage is collected separately from the other refuse, then there remains another method for its disposal, which receives the commendation of your committee, namely, cremation. When garbage is separately collected, it contains from 50 to 80 per cent. of moisture. This fact has made its burning difficult. There is insufficient combustible material contained in the same to evaporate the large quantity of moisture contained in fresh garbage while burning up itself. For this reason it has been necessary to add coal to supply the heat in most of the American furnaces. They are nearly all so constructed that the wet material is thrown directly upon the grate bars. In the English furnaces the garbage and refuse are first thrown into an ante-chamber, where the material is dried before it reaches the grate bars. Your committee is not aware of the existence of a furnace constructed after the English pattern where garbage alone, without the addition of rubbish, ashes and cinders, has been consumed. It is, therefore, not in a position to state the actual results that would be found if garbage alone were burned in an English furnace. It seems, however, in view of the evidence before the committee, that it might be possibly found economical to subject garbage to a drying process before it is thrown upon the grate bars. With moderately wet garbage and suitably arranged apparatus it seems possible that the combustion might be effected with less coal than is now generally used. No intelligent experiments in this direction have, however, come to the attention of your committee, and no definite statement as to the economy of such a process can be given.

Besides the reduction of the kitchen garbage to grease and fertilizer, or its cremation, your committee is not able to designate any process by which the garbage of communities can be finally disposed of either economically or in a sanitary manner. If the garbage is disposed of separately there results the necessity of a separate disposal of the remaining material, consisting of ashes, cinders, rubbish, and dry combustible matter. Ashes and incombustible refuse can be safely wasted or dumped for filling in low ground. Dry combustible matter, of which large cities usually furnish a considerable amount, is best disposed of by being burnt in a crematory.

Your committee feels compelled to state, with reference to the disposal of these materials, that a separation does not seem to be economical or advisable, unless the conversion of garbage into salable products is an assured profitable business. It has not so been found in the larger cities of Europe, and separation is not there practiced.

(b) Combined Removal.—When no separation is made of the various waste materials and all are collected together, there is, in the opinion of your committee, but one way in which the final disposal should be accomplished; namely, by cremation. This is the system successfully adopted under these circumstances in many cities of Europe, and is growing in favor every year. (See statistics in appendix.) In England the burning of city garbage and refuse has been practiced in some cities for half a century. Considerable experience has, therefore, been gained regarding the most suitable construction of the furnaces and the manipulation of the material.

Within the last two years extensive experiments have been made in the cities of Hamburg and Berlin on the subject of garbage and refuse cremation, as already stated. The results there obtained with garbage that contains less combustible matter than the English and still less than the American garbage and refuse indicate, without any doubt, that a destruction of this material by fire can be an economical process, besides offering a thoroughly sanitary solution of the garbage question.

The European furnaces have not yet been introduced in America. Within a few years, however, a furnace resembling the English pattern, but apparently less efficient, has been erected in Montreal. The experience gained with it has been fairly satisfactory. The garbage and ashes are mixed, and they burn without the addition of fuel. It is found necessary, however, as was also found necessary in some cities of Europe, to sift the material and thus to free it from the fine ashes, which choke the fires.

Garbage in America contains more moisture than that in Europe, and this fact has made it appear as though cremating would not be as successful in this country; but your committee has reason to believe that the additional quantity of combustible material usually contained in the average American garbage more than compensates for this additional moisture, when the dry refuse and garbage are mixed. Without having a proper analysis at our disposal, we may say that to the eye there is no apparent difference in this respect between the mixed garbage and refuse of Europe and that of America.

In view of the results obtained during many years in England and lately obtained also in Germany, as fully given in the appendix to this report, there appears to be no reason why the same method of disposal, under the above mentioned limitations and conditions, should not be applicable to this country, by using properly constructed furnaces and having efficient workmen, thereby effecting a destruction of the material in a more sanitary way and probably also more economically than by other methods that have been tried.

Your committee finds that the recent reports from Hamburg, Zurich, and particularly the one from Berlin, have given material for a better understanding and judgment regarding the cremation of garbage than has been possible since the early English reports on the subject. A final report on similar experiments, with similar results recently gained in Paris, is also about to be issued.

The experience and results now before your committee indicate that the English pattern of cell furnaces with sloping ante-chamber for a preliminary drying and heating of the garbage give more economical results than the large and level American furnaces. It also plainly indicates that a skillful construction of the entire plant, and a skillful operation, requiring special training of the firemen, are prime requisites in obtaining successful results.

THE MICROBE OF YELLOW FEVER.*

I OWE the chance of the discovery of the microbe of yellow fever to the second case of the disease which presented itself to me at the island of Flores. This case, though it showed a mixture of various microbes, had, in a state of relative purity, the specific microbe, to which I have given provisionally the name of "bacillus icteroides," because yellow fever is known also under the name of typhus icteroides. I have said, "in a state of relative purity," because yellow fever is the prototype of the diseases of mixed infection. I have never found the "bacillus icteroides" alone in the autopsies I have made. It has been associated always with the micro-organisms previously referred to or among the numerous species of common microbes, or it has been impossible to find it because the other microbes, having entered the organism in its train, have ended by impeding its evolution and have even caused it to disappear entirely. The "bacillus icteroides" must be sought for in the blood and in the tissues, and not in the gastro-intestinal tube, in which, contrary to what might have been supposed à priori, I have never encountered it.

Upon the result of my investigations I will say that the isolation of the specific microbe of yellow fever is possible in only fifty-eight per cent. of the cases. The reasons for this are easy to understand. Before all, in the beginning of the disease, the "bacillus icteroides" multiplies very little in the human organism, a very small quantity of its toxin being sufficient to provoke in man the worst type of the disease. In the second place, the toxin, whether by itself or indirectly through the profound lesions it causes, especially in the digestive mucous membrane and in the liver, facilitates in an extraordinary manner every sort of secondary infection. According to my investigations, the "bacillus icteroides" is found in the circulating blood and in the tissues; the germ of yellow fever does not reside in the digestive tube, and its poison, instead of being absorbed through the intestinal walls, is fabricated in the interior of the organs and in the blood.

Morphologically this bacillus does not present at first sight anything characteristic. It is a little rod, with rounded extremities, united at best by pairs in cultures and in groups in the tissues, from two to four micromillimeters in length, and generally two or three times longer than it is broad. It is sufficiently polymorphous. Even in the cases that give the best results from the bacteriological examination, it is not easy to place the bacillus in evidence in sections of the tissues, on account of its extremely small number. In spite of this, by using the utmost care, one can find it in the organs, united usually in small groups and situated always in the minute capillaries of the liver, the kidneys, etc. Different modes of evolution can be used for diagnosis by exposing cultures, first for from twelve to sixteen hours to the temperature of the incubator, and afterward for other twelve to sixteen hours to the temperature of the air. This done, the colonies show themselves to be constructed with a flat central nucleus, transparent and azure, having a peripheral circle prominent and opaque. This peculiarity, which may be considered specific, may be made evident in less than twenty-four hours, serving to establish the bacteriological diagnosis of the "bacillus icteroides." Apart from this morphological characteristic, which suffices of itself to differentiate the microbe of yellow fever from all others previously known, the "bacillus icteroides" is endowed with some interesting biological qualities.

Once isolated, the exact bacteriological diagnosis of the bacilli does not require more than twenty-four hours. The disease is transmitted experimentally even by the respiratory tract to rabbits and guinea-pigs; the bacteriological examination of these cases shows, at least, the existence of a toxic process identical with that which takes place in man. It is then possible that the contagion of the virus of yellow fever may be effected even by means of the air, which is in accord with the dominant opinions in this respect. Up to the present time almost every sort of means has been tried in order to transmit yellow fever experimentally. These attempts gave no results, which explains why for many years the conviction has prevailed in the United States that this terrible malady was not contagious.

My experiments upon man reach the number of five. For reasons easily understood I have not used living cultures, but simple cultures in broth from fifteen to twenty days old, filtered with the Chamberland filter and sterilized, moreover, with the greatest caution by a few drops of formic aldehyde. In two of the individuals I tried the effect of subcutaneous injections and in the other three that of intravenous injections. These fortunate experiments, though few in number, are sufficient to illuminate in a manner unhoped for all the pathogenic mechanism, so obscure and so badly interpreted until now, of yellow fever. The injection of the filtered culture in doses relatively small reproduces in man typical yellow fever. The fever, the congestions, the hemorrhages, the vomit, the fatty degeneration of the liver, the headache, the backache, the nephritis, the anuria, the uremia, the jaundice, the delirium, the collapse, in fine, all that conjunction of anatomical and symptomatic elements which constitute by their combination the indivisible basis of the diagnosis of yellow fever, I have seen unroll before my eyes, thanks to the potent influence of the yellow fever poison made in my artificial cultures. This fact not only represents very valuable evidence in favor of the specific nature of the "bacillus icteroides," but it establishes new grounds for the etiological and pathological conception of yellow fever.

For the rest, the tenacious resistance to desiccation and to water I have found in the "bacillus icteroides" authorize me to admit that the diffusion of the virus of yellow fever can take place as well by air as by water. The experiments on animals show that infection by the respiratory tract is possible. With respect to the mechanism of infection by the way of fluids, a fact beyond doubt is that when the epithelium of the digestive tract is intact, in general it does not permit the entrance of any sort of pathogenic germ.

For a year, by work often interrupted, I have had the fortune to bring to this point our knowledge of this terrible infirmity, which represents the most grave and urgent sanitary problem throughout America. The ground covered is without doubt wide, but there remains yet much to go over. We have learned to know the specific agent of yellow fever; we have it in our power; we have studied minutely its life, its habits, its wants, its relations to external agents and to other small organisms; we have revealed the complicated mechanism of all the infinite manifestations which this agent determines in the human organism, and we have finally placed this disease, which a few months ago was a horrible mystery, on the same level as that occupied by the other great infectious diseases.

* From an address delivered by Giuseppe Sanarelli, M.D., at Montevideo, June 10, 1897, printed in the Medical Record, New York. Translated by A. C. H. Russell.

THE STRUCTURE OF BACTERIA.

THE actual intimate structure of micro-organisms is a subject which has as yet received but little attention from English bacteriologists. It is not revealed by the methods of staining, or indeed the amount of magnification which suffices for diagnostic purposes, and its study has the double disadvantage of requiring special skill and leading to no obvious and immediate results of practical clinical importance. Nevertheless, much time has been devoted to it by Continental observers, and M. Duclaux, in an excellent summary of our present state of knowledge, in a recent number of the Annales de l'Institut Pasteur, refers to a formidable list of forty memoirs bearing upon it.

The opinions expressed show a good many discrepancies, mainly arising from a common cause. Differences of structure in normal bacilli are hard to detect, for the whole protoplasm appears homogeneous; it is therefore necessary to study them either when they have become old and are commencing to disintegrate or with the aid of coloring reagents. The question then arises as to how far the appearances then presented may be taken as indications of the normal structure. The plasma of the bacteria is a gelatinous substance, readily coagulating with the aid of heat or reagents. This has been shown by Butschli, who has actually succeeded in squeezing out this gelatinous material from its envelope. The ease with which the jelly coagulates under different circumstances is one of the main sources of difficulty in its differentiation. One set of observers, among whom A. Fischer and Migula are conspicuous, regards a bacillus as consisting of a capsular membrane containing a mass of protoplasm with a central vacuole, but no nucleus. The vacuole, however, depends too much upon the viscosity of the protoplasm, and, therefore, upon external conditions, to have, in Duclaux's opinion, the importance assigned to it by them. Migula, in fact, considers that the division of a bacterium is preceded by binary fission of the vacuole. Butschli, on the other hand, has studied bacteria and larger, but almost as lowly, fungi, the cyanophyces, by faintly coloring them with acid haematoxylin. He distinguishes a bacterium into three parts, a membrane which does not take the stain at all, a faintly staining peripheral tone, and the much discussed deeply staining central body.

Butschli considers this central body to be, if not a nucleus, at least allied to one in its nature. He has twice, in the case of Beggiatoa, been enabled to detect karyokinesis in it. No difficulty is found in accepting this view as regards the cyanophyces, in which, although large, the central body does not entirely preponderate; but in the smaller bacteria it is found to occupy the whole membrane, the protoplasm being reduced to a mere semilunar thread at each end. This assumption that a bacterium consists practically entirely of a nucleus, with the nutritive protoplasm reduced to a minimum, has not been generally accepted by bacteriologists. Metchnikoff has well compared it to the condition in embryonic cells and in myeloplaxes—that is, where nutritive activity is greatest. Duclaux suggests that protoplasm is, so to speak, the kitchen for the nucleus, which, when in a very active state, can take in its food raw. It will possibly be found that when storage of starch, etc., takes place in a bacterium, protoplasm may be developed around the nucleus as a "tissue of reserve."

Another most interesting question is as to the histology of spore formation. Babes was the first to demonstrate in a number of bacteria, and particularly in that of diphtheria, minute particles taking a violet or reddish stain with methylene blue, and so standing out in sharp contrast to the blue ground.

They were most numerous at the center and extremities of the rod, as if associated with division and growth. He gave them the non-committal name of "metachromatic granules."

Butschli has described them as mainly occurring in the thin protoplasmic layer already mentioned. Certain of them appear to take part in the formation of spores, and here, again, a difference of opinion has arisen.

Ernst described "sporogenic granules" staining with hot, but not boiling, methylene blue, as appearing in certain bacilli under conditions favorable to spore formation, and running together in places to give rise to spores. But Bunge pointed out that these granules were present in some bacilli which did not form spores, and absent in typical spore-bearing forms such as the anthrax bacillus; and farther, that, unlike spores, they did not resist boiling water. He himself describes granules staining less easily than those of Ernst, which appears to fulfill these conditions. They require treatment with an oxidizing agent before they are capable of taking the ordinary stains.

In the anthrax bacillus three or four rounded granules can be seen, which eventually fuse into an oval spore. These granules withstand the action of boiling water, and in this respect and the difficulty with which they are stained agree throughout with the spores themselves. This would seem to show that the difficulty of staining the latter is due to a quality of the material of which they are composed, and not to their being enveloped in an impermeable membrane.

One final point remains for solution—to bring the conclusions of Butschli and of Bunge into harmony it must be shown, as Duclaux points out, that the granules of the latter are formed by the "central body" of the former. This is an important thesis for future observation.—British Medical Journal, London.

THE SALZBURG FESTIVAL.

For hundreds of years the traditional fair with the accompanying popular amusements was held at the Linzer Gate of the old town of Salzburg. The fair has been abolished on account of a complete change in commercial conditions in this region, but the amusements have survived and have been made a festival of the people. Much of the old Dultplatz has been built upon, so that there is not room there now for this fete and it has been removed to Franz-Joseph's Park, a large and beautiful new park near the city.

The historical character which has been given to the festival is a sign of the times, for the study of the customs and habits of the people has become fashionable; the nearer the railroads and the telegraph bring us to one another, the more do we seek to restore and preserve the old customs. This same object was kept in view in arranging the Salzburg festival, the chief attractions of which were a procession of the "Berchten" (fairies or witches of South German legends), a great wrestling match, and a procession in peasant's dress, with valuable prizes for the finest costumes.

The giant Samson and the two dwarfs were brought to the fete from Tamsweg, a little place in Longau. Our illustration shows the strange figure of the giant, which plays such an important part in this little place on Corpus Christi day. As long as can be remembered there has been a procession after the church ceremony, which some declare to be a remnant of a heathen summer festival, while others say it corresponds with the "Maigrafenfahrt." But the parade figure of Samson seems to have survived from the Corpus Christi processions of the last century, of which old historians give a very full account. Then all the heroes of the Bible appeared, even Christ and his disciples being represented.

Samson is represented with a helmet, armor and a sword. A strong man carries the figure on his shoulders, finding a place to look out between the leather straps that form a part of the garment, and the two dwarfs walk near; music precedes them and innumerable followers take a lively interest in the spectacle. We are indebted to the Illustrirte Zeitung for the cut and the interesting details.

THE TAMSWEG SAMSON IN THE PROCESSION AT THE SALZBURG FESTIVAL.

FOREMOST IN LETTER WRITING.

There are 200,000 post offices in all the countries of the world enjoying organized facilities of correspondence, and of this number 70,000 are in the United States, says the New York Sun. In respect of the number of letters and postal cards written and received, the revenue and disbursements of the department, the extent, promptness and accuracy of letter delivery, as well as in the number of post offices, the United States stands at the head of all other nations, Germany following second, Great Britain third, and Austria, among other European nations, fourth. The United States sell in a year 2,000,000,000 two-cent stamps, which is equivalent to 1,000,000,000 letters sent through the mails in a year. In addition to this, the United States sell in a year 600,000,000 one cent stamps, some of which are used for letters, though a larger number for newspaper and circular postage, 12,000,000 three cent stamps, 20,000,000 four cent stamps, and 30,000,000 five cent stamps, mostly used for letters sent from this country for foreign delivery. More than 1,000,000,000 letters a year, therefore, paying full postage, and exclusive of postal cards, are written in the United States.

The business of the German and of the English post office department is less than half as large. The postal card system in Germany is in much more general use than in England, and it is for this reason, perhaps, that Germany keeps ahead of England in respect of the amount of correspondence done. The number of post offices in Great Britain, by the last official statement, made on January 1, 1897, was 20,275, exclusive of what is called in England "the road and pillar letter box." There are 150,000 employes of the post office department in Great Britain, of whom 6,500 are women and girls. The number of post office employes in Germany, where telegraphic communication is a part of the post office system, is 125,000. The number of letters handled by the Austrian post office department in a year is 730,000,000, and of these two-thirds are handled in that portion of the ampire which comes under the designation of Austria, and one third only is handled in the portion officially known as Hungary. The Germans, in Austria as well as in Germany, are great letter writers, and in those cities of the United States in which the German population is numerous more letters are written in a year proportionally than in cities in which the German population is small.

The Italian post office handles 350,000,000 letters a year, the post office department of Spain 130,000,000, of Canada 100,000,000, of Holland 100,000,000, of Belgium 125,000,000, and of Russia 200,000,000, a considerable proportion of which is carried on what are called "the mail coach roads," upon which service the imperial government maintains 30,000 horses. In France the number of letters handled by the post office department is about 700,000,000 in a year, and the receipts of the department are about $35,000,000, or one-half of those of the United States. The French government, however, does a considerable express business, handling more than 40,000,000 parcels, at the rate of one to each inhabitant of the country in each year. The expenditures in the post office department in the United States exceed the receipts by from $8,000,000 to $10,000,000 in an ordinary year. When times are bad, there is less corresponding done.

CONCERNING PUMICE STONE.

An interesting report on the pumice stone industry in the Lipari Islands has been furnished to the British Foreign Office by Mr. Norman Douglass. Pumice occurs on most shores of the Tyrrhenian Sea and elsewhere, but that of commerce is at present almost exclusively obtained from the island of Lipari. It is a trachytic lava, rendered light and scoriaceous by the escape of gases, and every gradation can be traced, from this condition to the heavy vitreous matter of similar composition known as obsidian. Good pumice contains: Silica, 73·70 per cent.; alumina, 12·27 per cent.; potash, 4·73 per cent.; soda, 4·52 per cent.; oxide of iron, 2·31 per cent.; water, lime, etc., 2·47 per cent.

Most of the volcanoes of Lipari have ejected pumaceous rocks at some period or other, but the best stone is all the product of Monte Chirica, with its accessory craters, Monte Pelato and Forgia Vecchia. The district containing the deposits lies in the northeast of the island, and covers an area of about three square miles. The mineral is excavated in various parts of it: in the plateau of Castagna, on the sides of Monte Chirica and Monte Pelato, at Perea, near the seashore of Acqua Calda, and at one or two isolated points. To this end tunnels or galleries are dug into the layers of denuded lapilli and ashes that have gradually covered the pumice. The mineral is sometimes found near the surface, at other times under a layer of white tufa. Digging is not difficult. The tunnels are lighted at intervals by small terra-cotta lamps of antique form, and are so narrow that two men can barely pass. The deficiency of air is soon felt. Sometimes, when a stratum of pumice has been reached, cross cuts are run to gain a larger supply of pumice out of the soft material in which it lies embedded. It is often a matter of

speculation how soon pumice will be reached, so that many tunnels are abandoned while others are worked for long periods. The output may be large one day and almost exhausted the next, or the quality of the stone may change. It has been observed that certain localities produce certain qualities; thus, some of the best pumice comes from Acqua Calda and Monte Pelato, while the inferior variety, known as "alessandrina," is found at Castagna. The number of tunnels actually in working has been estimated at 250, but they vary greatly in size. The number of workmen also fluctuates according to their personal requirements and the season of the year, but has been estimated at about 1,000, of whom 600 are miners.

Pumice is brought to the surface in large blocks or in baskets, and is carried to the village of Canneto by hand or to the seashore, to be taken there in boats. About one-fourth subsequently reaches Lipari by sea. It is there generally stored in the sheds of the merchants, and unless they are in a hurry to dispose of their stock, it is allowed a month to get thoroughly dry. This reduces the weight and shows the quality. After that, large blocks weighing 15 pounds and upward are allowed to crumble according to their cleavage into so-called "biscotti," and all the pumice is then assorted according to its size into (1) large ("grosse," lumps down to the size of a fist); (2) medium ("correnti"); and (3) small ("pezzame," from two inches downwards). The quality is primarily a matter of texture. As pumice is used for polishing purposes, an essential condition is homogeneity of structure and freedom from included crystals. The stone must be neither too brittle nor too hard, and it is in these respects that the Lipari pumice surpasses that of other volcanic regions. After it has been divided according to its size, the large stones ("grosse") are again sorted into three superior qualities called "fiore," "quasi fiore" and "mordente." These are never filed.

After they have been selected, the remainder of the "grosse" are filed by hand, in order to remove asperities of surface and to see whether the stone is not too friable for use. They are then reclassed into first, second and third ("blanche," "dubbiose" and "nere"). Large pieces of inferior pumice, known as "rotonde," are never trimmed. Besides this, there is an entirely different variety called "alessandrina," which is cut with hatchets into brick-shaped pieces and used for smoothing oil cloth, and a heavy dark stone, "bastardone" (always trimmed), as well as many less important varieties. The "correnti," commercially termed "sorts," contain all varieties, and are generally exported as they are; the "pezzame" is usually, but not always, ground to a powder of more than ten different degrees of fineness, according to the work for which it is required.

So extensive are the deposits that the supply is practically inexhaustible. The pumice washed up by the sea is hardly ever collected nowadays. The number of tunnels could be increased indefinitely, and if they were worked on a larger and more systematic scale, the output would probably be trebled. Thus the superior material which is now obtained, not without danger to life, by running tunnels into the precipitous internal crater wall of Monte Pelato, could be reached by longer tunneling from the outside, where there are only a few caves at present. The only menace to the pumice industry lies in the introduction of artificial polishing materials.

THE QUEEN'S HINDOSTANI TUTOR.

THE Munshi Hafiz Abdul Karim, C. I. E., who teaches the Queen Hindostani, came to Windsor in 1887. He was then only twenty-three. He soon began giving lessons in Hindostani to the Queen, who now not only speaks that language fluently, but can write it with more than average correctness in the Persian character. Frogmore Cottage has been assigned to Hafiz Abdul Karim as a residence, and he has been joined there by his wife and his father. Abdul Karim is the second son of Khan Bahadur Dr. Hajee Mohammed Wazirad-din, first class hospital assistant in the Indian medical department. He was for some time in the service of the Nawab Jadla, as Assistant Wakil to the West Malwa Political Agency at Agra. In 1886 he became an Indian government clerk. In the following year he was appointed Munshi and Indian clerk to the Queen, and in 1892 became Indian Secretary to Her Majesty. We are indebted to the London Graphic for the cut and particulars.

THE QUEEN'S LIFE IN THE HIGHLANDS—HER MAJESTY RECEIVING A LESSON IN HINDOSTANI FROM THE MUNSHI HAFIZ ABDUL KARIM, C.I.E.

TECHNOLOGY AT THE TENNESSEE CENTENNIAL.

By MARCUS BENJAMIN, Ph.D., Member of the Jury of Awards.

THE people of the great commonwealth of Tennessee have celebrated the one hundredth anniversary of the admission of their State into the Union by an exposition in the city of Nashville, at which the industrial products of the world were exhibited. As a great object lesson, the Exposition was emphatically a great success, for it afforded a splendid opportunity, to those who were wise enough to visit it, of examining the rich natural resources of the surrounding territory, systematically displayed, as well as many of the manufactured products derived from these resources.

Conspicuous among the exhibits that told a story as if written by nature itself were those of the Southern and of the Nashville, Chattanooga and St. Louis Railways in the Terminal building. The former exhibit—that of the Southern Railway—had three conspicuous features. Agriculture, being the basis of all industries, was given the central place in the hall, while the products of forestry and mining were arranged on either side. The agricultural display consisted of a great variety of farm and garden products and showed the crops that flourish in the most productive regions of the Southern States, as well as the richness of the soil, the favorable climate and the labors of the people. There were specimens of oats, corn and rye from every State and rice from the Carolinas. During 1896 101,024,547 bushels of grain were raised in the eight States through which the Southern Railway passes. There were glass cases filled with silken yellow-leaved tobacco of Virginia and North Carolina, and still others in which the heavy, dark tobacco of Kentucky, Tennessee and elsewhere was displayed. Remarkable exhibits of fruits and vegetables were made, together with samples of the Muscadine and the more famous Scuppernong wine; indeed, it is claimed by some that the vineyard regions of the Southland are now able to produce wines "that vie with those of the valley of the Rhine and the sunny slopes of France."

Of cotton and its products more must be said. Raw cotton from the States of Mississippi, Tennessee, Alabama, Georgia, North and South Carolina, was shown, and from these States 4,758,394 bales were produced in 1896. A sign with the words "The Southern Railway cities and towns have erected a million spindles in two years" was conspicuously displayed, and there seemed little doubt as to the verity of the statement, for there were samples of yarns, hosiery, cassimeres, cheviots, stripes, plaids, shirting, suitings, cottonades, ticking, fine bleached cloth, doilies, tray covers, towels, napkins, goods for aprons, goods for either drawn work or embroidery and goods for all kinds of underwear, as well as all kinds of thread. There are now in the States of Kentucky, Tennessee, Mississippi, Alabama, Georgia, the Carolinas and Virginia 434 cotton mills, with 3,451,-631 spindles and 90,108 looms, besides 72 knitting mills. Of these, 249 cotton mills and 37 knitting mills are on the line of the Southern Railway. These mills have 2,-304,367 spindles and 66,561 looms, being two-thirds of all the looms and spindles in operation in the South east of the Mississippi. The products of the woolen mills along the line of this railroad were represented by a great variety of fine merino doeskins, jeans, diagonal cloth and many samples of various "all wool" cloths. There are some 88 woolen mills distributed among the States as follows: Alabama, 2; Georgia, 5; Kentucky, 18; Mississippi, 1; North Carolina, 13; Tennessee, 25; and Louisiana, 24. Of the total number given, about 15 are also cotton or knitting mills.

The lumber interests of the South are now one of its most important industries, and an interesting feature of this exhibit was specimens of the native woods, many of which were planed and varnished so as to show fully

the beauty of the natural grain. The manufactured articles on exhibition included ax and hammer handles, spokes, spigots and furniture.

Of considerable interest was the mineral exhibit. One side of the hall was wainscoted with slabs of marble. A great variety of the famous marbles of East Tennessee and Georgia was shown, and it will be recollected that the new Congressional Library building in Washington contains much of this beautiful mineral from these localities. Several interesting fancy marbles were conspicuous, notably the leparlite from near Charlotte, N. C., and a mottled gray variety containing fossil shells from Varnells, Ga. Blocks of granite from Richmond, Va., and Winston, N. C., gneiss from Jackson, Ga., and a stationary wash tub of soapstone from North Garden, Va., as well as slates and limestones of excellent qualities, were shown.

Of the metallic minerals, the display of iron ores was naturally a fine one, and it must be remembered that Alabama is now the third State in the Union in mining iron ore and the fourth in the manufacture of pig iron. Gold ores from mines in the Carolinas, in Virginia, in Georgia, and in Alabama were shown, together with casts of important nuggets; of these, one from the Reed mine in Cabarrus County, N. C., found April 10, 1896, weighed 22 pounds. Tin, nickel, and zinc ores were also shown.

The display of kaolin and clays was not only fine, but it is proper to add some of the very best deposits of kaolin in the United States are to be found in the Carolinas.

As yet no great potteries have been established in the South, but specimens of manufactured wares made in East Liverpool and in Trenton from Southern clays were shown. Of passing interest was the black pottery made by the Cherokee Indians in North Carolina. That the great demand for mineral waters is not ignored in the South was apparent by the many varieties shown as coming from points along the line of the railway.

The exhibit of the Nashville, Chattanooga & St. Louis Railway was by no means inferior to that of the Southern Railway, but as the territory covered by this road is not so great, it failed to produce so effective an impression of the resources of the South as its greater rival.

Of agricultural products, more than one hundred and fifty specimens of crops, garden vegetables and textile grasses, all labeled, were shown. A special feature of this exhibit was the showing of the variety of products that could be obtained from single localities, and there were exhibited seventy-three separate and distinct crops taken from a single farm of twenty-five acres. The forestry exhibit was a splendid exhibition of the woods of Tennessee. Five hundred sections of trees so prepared as to show the grain of the wood were to be seen. From one farm in Montgomery County forty-five single specimens of hardwood were procured. In all one hundred and seventeen specimens of wood from Tennessee were shown by the Nashville, Chattanooga & St. Louis Railway.

The largest hardwood lumber market in the world is Nashville, and the value of the annual output of lumber, including staves, spokes, hubs and bent work, is $9,078,-686. Specimens of nearly every mineral of economic value to be found in Tennessee were shown, as well as the varieties of iron ore, asbestos, tripoli, corundum, bauxite, manganese, coal, and several varieties of phosphate of lime, also hydraulic cement rock and potter's clay, marbles, both white and variegated, building stone of fine polishing qualities, both sandstones and limestones, grindstone grits, lithographic stones, and others of value.

An interesting exhibit of yellow tobacco was shown, and it is claimed that the success that has attended the cultivation of this variety of tobacco will lead to the developing of much land in Tennessee hitherto believed to be sterile.

Adjacent to the Agricultural building were several fields containing cotton and tobacco plants showing the methods of cultivation, and in the building itself the curing process was practically shown.

Of perhaps more distinct value in technology was the exhibit in the Agricultural building of the German Kali Works. Of course not so imposing an array of the salts was shown as was the case in Chicago, but "comparisons are odious," and it is sufficient to say that the kainit and other minerals so extensively used for fertilizing purposes were artistically displayed. Naturally in this building the exhibits in which we have most interest were articles used in the preparation of food, and of this character were the different varieties of gelatine on exhibition. Of similar nature was the "cotosuet," composed of prime cottonseed oil and used as a shortening. The beef extract, both in the liquid and solid forms, was a conspicuous feature of the exhibits made by the large packing firms of Chicago. Also in the Agricultural building was the unique exhibit from far-away Utah. Conspicuous among the products offered for inspection from the fertile valley of Salt Lake was the sugar from the beet sugar works at Lehi, where each year nearly 5,000,000 pounds of sugar are made from beets grown in the vicinity, and for which the farmers receive $150,000. As the bitter accompanies the sweet, so to counterbalance the sugar, Utah exhibited the salt produced by three companies whose works are in the immediate vicinity of Salt Lake City. Prof. Talmadge, of the University of Utah, describes the method of producing the salt as follows:

"The water is lifted by the aid of centrifugal pumps to a height of 14 feet above the lake surface; it is then conveyed through flumes to the evaporating ponds, which are from one to two miles inland. The largest of these companies is the Intermountain Salt Company, which claims to have 974 acres in ponds. Part of this constitutes a storage basin. Pumping is begun early in March and is continued about 150 days. The pumps have a capacity of 14,000 gallons a minute and run ten hours a day. By the time the ponds are filled the evaporating season is well advanced, and about the same supply is needed to keep the brine at the proper level. About one-tenth of the amount of brine carried to the ponds is returned to the lake after the deposition of the crystals. The salt deposit, as reported, averages 6 inches depth and yields 900 tons to the acre, or at the rate of 150 tons an inch depth to the acre. The pond floor consists of saline mud which seems to be practically watertight. When the salt harvest begins, usually in August, movable railway tracks are run into the ponds and the crop is gathered into hand cars. It is then heaped in large symmetrically constructed piles and as required is conveyed to the works. With so simple a process of production, the manufacturers are able to offer the coarse salt at from seventy-five cents to a dollar a ton. The refining process comprises the following operations: 1. The crude salt is run through a drying cylinder. 2. The dried coarse salt is subjected to fan action, whereby the finer powder is removed; this takes out most of the efflorescent sodium sulphate, which has assumed the condition of dust during the drying process. 3. The granular salt is then ground to varying degrees of fineness and is offered for sale as dairy salt, table salt, etc. The lake salt so prepared is of a high grade of purity; indeed, it may challenge comparison with commercial salt from any other source."

The mineral exhibit from the new State was of interest and the rich gold ores from the Mercur and Golden Gate mines testified to the great value of these deposits, which are much nearer at hand than those of the Klondike. The present output from the Mercur mine is said to be 200 tons a day, with an average value of thirteen dollars a ton. "Conservative estimates place the amount of ore in sight at three million dollars and yet the door of the mine has just begun to swing upon its hinges." And Utah is also rich in silver and iron ores, and then its hydrocarbon minerals, including gilsonite, elaterite and ozerkerite, must not be forgotten. Well may one wonder as to "what shall the harvest be?" when the resources of Utah are developed.

By far the most important exhibits were in the Commerce building, as the edifice was called in which articles belonging to the departments of manufactures and liberal arts were housed. Unfortunately for this paper, however, there were comparatively few exhibits that were of conspicuous interest. In the way of heating and illumination there were several fine displays of stoves and furnaces. The stoves came chiefly from the large factories in Detroit, and several forms of cooking stoves were shown with arrangements for both coal and gas, thus providing a means by which during the colder months the heavier fuel was to be used, while in summer the more convenient gas was to be employed. Many of the designs were elaborate, and one stove was shown in which the iron had been entirely replaced by aluminum. For this variety the claims were naturally cleanliness and lightness. Several furnaces for heating were on exhibition, and the chief characteristic to be noted in these was the passage of the smoke over the bed of the furnace in such a fashion as to consume the carbon particles. They were also built so that they could be cleaned rapidly and without difficulty. An exceptionally fine display of lamps was made by the well-known Rochester Lamp Company.

The costliest exhibit in the building was that of an elaborately carved altar, valued at $8,000, on either side of which were two cathedral windows containing the handsomest stained glass ever exhibited in the South. They were of American manufacture. On the floor were tiles from Zanesville, Ohio, of new and pleasing design and specially adapted for flooring. These were one of the few novelties that were to be seen in the Exposition. On the eastern aisle was an exhibition of some exceedingly well made tiles from a Southern factory near Asheville, which has recently been started and from which it is said that the tile work in Mr. George Vanderbilt's home at Biltmore is made; indeed, the clay from which the tiles were made is obtained on the estate itself. These were free from crazing and the glazing in consequence was very uniform. Some interesting specimens of the so-called Tiffany architectural brick were in the immediate vicinity and were of excellent manufacture.

Also in the same aisle was an exhibit by the Dupont Powder Company. It consisted of specimens, neatly installed and well labeled, of the crude materials used in the manufacture of powder, that is, twigs of wood and the resulting charcoal, together with sulphur and saltpeter. Then followed the various forms of shooting and blasting powders, as well as specimens of smokeless powder. There were no exhibits from any of the great drug houses of the country, although one enterprising firm from New York exhibited its emulsion of hypophosphites of soda and lime, showing the crude materials and also an upright tube filled with the emulsion, to demonstrate that it did not separate on standing. During the life of the Exposition this tube, fully six feet long, stood, sentinel-like, in front of the exhibit, and even at the last it was quite impossible to see any evidence of separation. Adjacent to this was shown by a Philadelphia firm a most palatable mixture of cod liver oil and port wine, in which the taste of the oil was completely disguised and in fact made so agreeable that a physician's prescription of such a medicine would be gratefully received by even a well person.

There were five exhibits of beers made by firms in Milwaukee, Cincinnati, Louisville and Nashville, and although samples were not given away, still the attractive manner in which the beer was displayed caused many to admire the installment. One exhibit in particular consisted of an enormous beer bottle, composed entirely of smaller bottles.

Flavoring extracts, perfumes and soaps were exhibited by several firms. One of the Nashville wholesale druggists had excellent varieties of perfumery made from crushed violets and crushed roses, that were unusually strong and persistent in their odor. Flavoring extracts made from the fruits themselves, together with specimens of fruit in the menstruum, were among the attractive exhibits of this variety. The peach and strawberry extracts were uncommonly strong and appetizing. Another firm in this line had an exhibition of "Standard Color Pastes" which were free from all harmful and injurious ingredients and were recommended for use in giving "color touches to food materials." It is claimed that for the use of coloring lunch tables there is nothing like them. Such effects as are needed in pink, green, or violet lunches are readily obtained by these harmless preparations. Nine rich shades of these pastes were shown and they are soluble in milk, water or spirit. They are fast to light and unchanged by fruit acids. This same firm exhibited an eau de cologne that closely resembled the celebrated brand made by Farina, "opposite the Cathedral," in musty and dirty old Cologne.

In the foreign section of the Commerce building the exhibits in technology naturally ran to objects of art. The most important of these was pottery. The exhibit of the Royal Copenhagen wares was indeed fine and included not only vases and plaques, but also several of the interesting reproductions of animal forms for which that factory is noted. One or two porcelain fish and a lobster on a piece of brick were characteristic specimens. Adjoining the pottery exhibit just mentioned was that of the Widow Ipsen's famous terra cotta wares. Statuettes and vases, especially those imitating in their general appearance and decoration the beautiful forms of ancient Greece, were notable. It is such exhibits as these two that have a great value in showing our native manufacturers their deficiencies. Italy had several exhibits of her characteristic majolica wares, and in one case the son of the potter himself accompanied the exhibit; and of more than passing interest is the fact that the boy, finding a satisfactory clay on the grounds, had reproduced several of the favorite patterns of his father's ware in Nashville clay. These were baked and then crudely decorated with paint, after which they were sold as souvenirs. The name of the lad was G. Bonato. Small statuettes with clever reproductions of native costumes, modeled by hand in clay and then baked, were likewise shown in the Italian section. Many of these figures were colored by hand. They were conspicuous among the artistic objects of the Exposition, and were worthy of high praise.

Sweden also sent specimens of her ceramic wares from the well known potteries of Hoganas and Rörstrand. Indeed, the American potters deserve the severest censure for making no exhibits, and were put to shame by the potteries from over the seas.

A new variety of iridescent glass, suggesting in form and appearance specimens dug up in Cyprus and elsewhere, were exhibited by a Danish firm. The brilliant and gaudy varieties of Hungarian and Bohemian glass were there in all their beauty and called forth pleasant memories of the Austrian section in Chicago. There was silver filigree work from Italy and an English exhibit of solid silverware. But nowhere in the Exposition was the Tiffany glass shown, and nowhere were the splendid works of our American silversmiths to be seen. Then there were laces from Belgium and laces from Russia. Also samovars and furs from the land of the White Czar, but not even so much as the head of a buffalo from an American dealer in furs.

A novelty from England was the tabloids of compressed tea, which were recommended as being "convenient, portable, economical, and reliable." One or two tabloids placed in a cup, which must then be filled with fresh boiling water, stirred and allowed to stand for a minute or two for the purpose of allowing the sediment to settle, yield a comfortable cup of tea. An interesting varnish enamel called "Psycroganome" was exhibited by a firm from Italy. This varnish, which comes in some twenty colors, is applied with a brush and forms on drying a hard enamel which resists the action of hot water, steam, and even acid solutions containing as high as two per cent. of sulphuric, hydrochloric, or nitric acid. It has been largely used abroad in hospitals, where in consequence of the ease with which it can be washed, and as it is not affected by disinfectants, it has proved of great value from a hygienic point of view. It has been used by the Italian government in large quantities in the interior of several of their recently constructed men-of-war.

In the remaining buildings there were but few exhibits that come within the scope of this article. Naturally in the Woman's building were many interesting specimens of ceramic wares painted by American women, but for the most part they were on foreign bodies. An exception to these were the beautiful vases and bowls exhibited by Miss Louise McLaughlin, of Cincinnati, who was associated with Mrs. Bellamy-Storer in the Pottery Club that led to the founding of the Rookwood Pottery.

In Machinery Hall was a most interesting exhibit—the Laflin & Rand Powder Company. Not only were samples of charcoal, sulphur and saltpeter shown, but also the various grades of saltpeter made by them. In addition, the different varieties of gunpowder, as well as mining, blasting and smokeless powders, were shown. This exhibit was especially attractive for the reason that it included a model of a powder mill worked by electricity. Although the actual manipulation was not shown, still the machinery in miniature was there and in actual operation.

The Mining building contained much that was of interest in the way of ores, minerals and their products, including a number of clays with the resulting ceramic wares. One attractive exhibit was specially notable. It consisted of a small structure or building made of fine pressed and ornamented brick erected by a firm in Nashville, roofed over with interlocking clay tiles from Chicago, similar to those used on the German government building at the World's Fair.

Doubtless in this necessarily brief and hurried summary of what appealed to the writer as being of interest in the department of technology there is much that is missing, but if there is any lesson to be derived from the exhibits at the Nashville Exposition it is that there is an individuality in the goods made abroad and which it is sad to say is lacking in our home manufactures. The United States, which should lead in every kind of manufactures, as it does in some few cases, will never create a distinctive class of goods until they cease to be imitators of foreign wares. May the time soon come when all kinds of things made in this country shall be as clearly distinctive of the United States as is the cotton gin invented by Whitney, the sewing machine of Howe, the telegraph of Henry, or the telephone of Bell.

A press dispatch says: "The discovery of petroleum is reported from Alaska. Some gold prospectors several months ago ran across what seemed to be a lake of oil. It was fed by innumerable springs, and the surrounding mountains were full of coal. They brought samples of the oil to Seattle, and tests proved it to be of as high grade as any ever taken out of Pennsylvania wells. A local company was formed and experts sent up. They have returned on the steamer Topeka, and their report has more than borne out the first reports. It is said there is enough oil and coal in the discovery to supply the world. It is close to the ocean, and the experts say that the oil oozes out into the salt water. It is said that the Standard Oil Company has already made an offer for the property. The owners have filed claims on 8,000 acres."

ENGINEERING NOTES.

The dust collected from the smoke of some Liege furnaces, burning coal raised from the neighboring mines, produces, when dissolved in hydrochloric acid, a solution from which considerable quantities of arsenic and several other metallic salts may be precipitated.

Licata, on the south coast of Sicily, at the mouth of the Salso, the ancient Himera, is about to build a large commercial harbor in the expectation of drawing the trade from the East that now goes to Naples and Brindisi, as it is on the direct route from Port Said to Gibraltar.

The weight of a given bulk of cast aluminum being known, the relative weight of similar castings of the common metals can be roughly found by multiplying by 2·9 for soft steel or iron; by 3·12 for copper; by 3·41 for nickel; for silver, 4·38; for lead, 4·4; for gold, 7·5; and platinum, 8·35.

Burma grows a hard wood called Pyinkadoe which, the British have found, makes excellent railroad sleepers. The wily Burmese, however, who sell the wood, having discovered that the British engineers know little about it, have taken to dyeing cheap wood a reddish color and palming it off for Pyinkadoe.

The total tonnage of the fleet of the Hamburg-American line is 290,000 tons, excluding the river boats which run to Heligoland and Norderney. This total places the company in the first place of all steamship companies, the second being the North German Lloyd, with a total tonnage of 265,000 tons, next the Peninsular & Oriental Company with 240,000 tons, and fourth the Messageries Maritimes with 220,000 tons.—Uhland's Wochenschrift.

When some thirty years ago the Japanese Steamship Company (the Mitsu Bishi Company) was founded, it had a fleet of some half a dozen ships. In 1870 it commanded over six sailing vessels and thirty-six steamers. In 1885 another company was incorporated with it, and at the present time the company possesses sixty-seven steamers, with a total tonnage of 133,600 tons. Orders have been given for twelve new steamers of 5,000 tons each, and the purchase of six more is being considered.—Stahl und Eisen.

There are thirty shields at work upon the construction of the Central London Railway, and over three thousand men engaged. The company has just completed half the tunneling process and put the two circular tubes to shape, which are to be run side by side for about five miles. Considerable trouble has been experienced at the Bank station—which is to be the City terminus, and not Liverpool street, as at first intended—owing to the City sewage pipes being in such close proximity. According to The Railway News, Christmas of next year is the earliest possible date of opening.

The right of working the Elba iron ore mines has been accorded to M. Tonietti, son of the previous concessionaire, on the basis of a royalty of 7·25f. per ton of ore exported, says The Engineering and Mining Journal. The royalty is a heavy one in comparison with the 4·50f. obtaining in the previous contract. According to the new contract, the annual output must not be less than 100,000 tons nor more than 200,000 tons. The concessionaire must employ a certain number of workmen and must keep the Follonica charcoal furnace in blast. After the exportation of 2,000,000 tons of ore, the royalty will be reduced one-third.

The London Trade Journal says: "The managers of the Saxon state railways are stated to be planning the establishment of a railway museum, which will be located in reserved rooms of the general railway building at Dresden. A vast number of exhibits have already been collected, particularly of models, printed matter and drawings, which partly belong to the very earliest railway period, and which for this reason will probably claim the attention not only of persons conversant with railway affairs, but of the educated public generally. When the opening of the museum will take place is not settled yet; it is only certain that in the first instance the close of the Leipzic Industrial Exhibition will be awaited, because a great portion of the objects to be put into the new museum are at present on exhibition there."

The Alpine-Montangesellschaft, in Austria, says The London Iron and Coal Trades Review, is really a federation of the chief works in Styria and Carinthia, and it has grown in importance and influence since it was founded, nearly twenty years ago, until now it employs 15,732 hands—of whom 417 are women and 507 children—and produced in 1896, 880,000 tons of brown coal, 166,000 tons of iron ore, 252,000 tons of pig and 134,000 tons of half and wholly manufactured iron and steel. Ten works owned by the Gesellschaft produce pig iron, three produce Bessemer steel and four produce open hearth steel. The total output of both descriptions was in metric tons: In 1896, 44,992 tons Bessemer and 121,472 tons open hearth. More than 20 per cent. of the total output of pig is manufactured with charcoal fuel, while brown coal is chiefly used for the remainder.

Painting gas holders by a compressed air spray has recently been tried by the Turner Machine Company, of New York City, with complete success, and it is stated, says Engineering News, with considerable economy over painting by hand. The painting was done on the gas holders of the Equitable Gas Company, of New York, which are located at Fortieth Street and Avenue A. In doing the painting the holders were first lowered and the top and three 2 foot sheets of the sides were painted, working from the ground. The holder was then gradually raised as the painting of the sides progressed. Owing to the necessity of using the tanks for storage, it is stated that the work was frequently interrupted, and there was only one day during which the work progressed steadily. On this day the top and 18 sheets of the sides were painted on a holder 90 by 90 feet and 24 sheets high. The work was carried on from 8:30 A. M. to 5 P. M., and the area painted was between 16,000 and 17,000 square feet. Three men, using two sprays, did the work, at a cost for labor of $6.25, or less than half a cent per square yard. About the same amount of paint was used as would have been the case in painting by hand. A man with a brush can [illegible] on 1,200 to 1,500 square feet per day.

ELECTRICAL NOTES.

Dr. Jameson has taken charge of the construction of the transcontinental telegraph line across Africa from north to south. For the present it will not extend beyond Lake Tanganyika.

The best results hitherto obtained in all attempts to make an electric cell which should consume carbon are those of Bartoli and Papasogli, whose cell consisted of platinum, carbon and caustic soda solution. The voltage obtained by this method was 0·2 to 0·3 volt. Mr. Coehn has made further researches on the same problem, and by a cell which has for its anode carbon, for its cathode lead peroxide, he has obtained as much as 1·06 volts. The great objection to this battery is the high price of lead peroxide, which makes it useless for practical purposes, though as a scientific curiosity his cell has great merits.—Uhland's Wochenschrift.

"The Bibliography of X Ray Literature and Research, 1896-1897," will be published in a few days by the Electrician Printing and Publishing Company, London. The book is edited by Mr. C. E. S. Phillips, who has also contributed an Historical Retrospect, and a chapter on "Practical Hints on Roentgen Ray Work." The same company also issued at the end of October a new work by Messrs. Fisher and Darby, entitled "The Student's Manual of Submarine Cable Testing." The publication of this work is opportune from the fact that the great cable companies now require on the part of their operators and probationers a more general acquaintance with electrical work, and Messrs. Fisher and Darby have written a book which is intended to serve as a manual for young men engaged in the cable service or who may contemplate selecting that career.

The increased use of electric power during recent years has led to a largely increased demand for mica for insulating purposes. But the producers of mica have not found in the electric demand any relief from the state of affairs which was a continual source of loss to them before it began. Large sizes and good shapes of mica such as are required for insulation purposes were always marketable, but the difficulty remained of disposing of the waste or scrap which forms so large a percentage of the output of mica mines and accumulates so rapidly at mica-cutting works. Through the ingenuity of Mr. H. C. Mitchell, of Toronto, this waste mica has now a value, though no doubt a small one as compared with the merchantable sizes. It is being utilized as material from which to manufacture coverings for boilers and steam pipes to lessen the loss of heat by radiation, mica being a good non-conductor of heat as well as of electricity.

Some interesting observations concerning the physiological effects of electric currents have been made by M. Dubois, says The Electrical Engineer. He finds that the effect depends much more upon voltage than upon intensity. With the same voltage, for instance, a fall of the resistance from 270,000 to 72,000 has no effect, at least as far as the minimum of perception is concerned. But a profound effect is produced by the insertion of external resistances, owing to their self-induction. Even the most non-inductive resistances have a marked effect. The inductance of the human body is practically zero, and hence the great difference produced by the slightest internal inductance. But the effect of an external resistance may be compensated by inserting a capacity in the circuit. In one case quoted a capacity of 0·0045 microfarad re-established the physiological effect, which had been canceled by the insertion of a resistance of 600 ohms.

The trial trip of the New York Fourth Avenue underground trolley took place October 31, and was a success. One of the new electric cars left the Thirty-second Street stables about 11 o'clock forenoon, ran to Forty-second Street, then down to Astor Place and Broadway, and back to the stables, making the round trip in thirty-five minutes, which is about schedule time. There followed along behind it, as contrast between what was and what is to be, one of the old stage-like cars of the style of 1850, drawn by two horses, and resurrected for the occasion. The new car was greeted by cheers along the route. It made no stop for passengers, but frequent stops to test its mechanism. W. A. Pearson, electric engineer of the company, acted as motorman, and M. Marks was its conductor. President Vreeland, General Superintendent F. D. Rounds, Chief Engineer F. S. Pearson, General Master Mechanic Thomas Mills, James Regan, general foreman of the Fourth Avenue division, and other officials of the road were passengers. It is expected that the new cars will be running regularly in a very few days.

Starting from the fact, which is obvious even to the unscientific person who has handled a chimney lamp, that gas at a temperature above red heat may emit absolutely no light whatever, it might easily be assumed that the temperature of the glowing residual gas in a Geissler or other vacuum tube was really very high indeed, says The Electrical Engineer. E. Wiedemann and Hittorf, as well as Warburg, have stated cautiously that the temperature of the residual gas when emitting light was probably well below red heat, a conclusion which ought not to be very difficult to arrive at when the small total amount of heat emitted is considered. Mr. R. W. Wood has recently endeavored to settle the matter definitely, and his results have been published in The Physical Review. In order to obtain the different temperatures in different parts of a stratified discharge he used a bolometer, consisting of a loop or spiral of very fine platino-iridium wire. The constant current was used from a 600 cell accumulator battery, and the tube was a Hittorf one. The details of the experiments and the results would occupy too much space to be set out here, but in every case it seems that the rise of temperature as measured in the way indicated is only a matter of from 2 degrees to 10 degrees C., according to the gas used and its pressure. The temperature is lower in the dark spaces than in the bright ones, so that it is clear that a part of what was measured was simply "light" measured as "heat." The method is not free from difficulties, but the results so far as they go support the contention that if it were only possible to use it a vacuum tube method would convert a greater proportion of electrical energy into light than any other means of electric lighting. Unfortunately there seems little or no likelihood of its being or becoming possible.

MISCELLANEOUS NOTES.

Menelek, of Abyssinia, is running Kaiser Wilhelm close in the variety of his accomplishments. He showed the French envoy, M. Lagarde, the plans he had drawn with his own hand for his new palace at Addis Adaba. When the first sewing machine he had seen came to him out of order, the Negus looked it over, found out what was wrong, and repaired it himself.

The writer of an article in a recent issue of the Marine Rundschau has laid before his readers a carefully thought out estimate of the fighting values of the various fleets expressed in terms of units. After dealing with the fleets of England, France, Russia, Germany, Italy, the United States, and Japan, the conclusion is arrived at that there is only one sea power of the first rank, namely, England. Expressed in units the author of the article estimates the English fleet at 1,091, the French at 466, the Russian at 290, the American at 195, and the Japanese at 170.

Admiral Makaroff, who has just returned from his expedition, expresses his opinion that it is possible to travel to Siberia by water through the Arctic Sea. That fact has been demonstrated; but what the admiral means is that it will be found possible to make the voyage every year. In some years the Kara Sea is completely blocked with ice, and it is suggested that pilot boats fitted with ice plows should be provided as an escort for the merchant steamers. Several vessels of the kind, called "ice breakers," have worked very successfully in America and elsewhere.

Mr. Ferrey, of London, England, has devised a simple improvement on cylinders, such as are used for storing compressed oxygen, carbon dioxide, etc. Instead of making them of smooth surface, as usual, he provides them externally with a screw thread. The result of this is twofold: A sudden stress merely produces an elongation of the cylinder, the thread tending to assume an axial position, while a slow increase of pressure above the maximum permissible, instead of resulting in an explosion, causes a slow breaking only along the grooves of the thread.—Uhland's Wochenschrift.

Progress in iron manufacture is exemplified in the sizes of the largest ingot and single piece of metal shown at the 1851 exhibition compared with the corresponding products of to-day. Forty-six years ago an ingot weighing 1 ton, and a forged bar weighing 7 cwt., were the best things forthcoming; ingots of 70 tons weight are now quite ordinary affairs at Messrs. Vickers' works in Sheffield, where also guns of 100 tons can be turned out. Their tools include seven planing machines that will each work up a surface 10 feet 6 inches square, and two others for dealing with armor plates 18 feet by 12 feet.

Edmund Carey of Benton was one of the early residents of Wilkes-Barre and was born August 12, 1822, on a farm at the lower end of town, now known as Carey Avenue, which has been named after the family. His father, George Carey, was one of the settlers who had the handling of the first anthracite coal in Wyoming Valley. He helped open a stripping in Pittston Township, now known as Plains Township, in 1815, and in the spring of that year loaded a raft with several others and took it down the Susquehanna to Harrisburg, where they sold the raftload of 40 tons of anthracite for $10. They were discouraged at such remuneration and left the transportation of coal dormant until 1820, when they took another raftload down and failed to find a buyer. They were so discouraged that they dumped their load of black diamonds into the Susquehanna at Harrisburg, and as far as these early pioneer shippers were concerned the opening up of a coal market was ended.—Wilkes Barre (Pa.) Record.

A new process for the artificial ageing of whisky is described in a chemical contemporary, and it is claimed that the process, which has hitherto taken some years to accomplish, can now be effected in as many hours. Briefly, it consists in exposing the largest surfaces of spirit and air to each other by means of a spray, and under the influence of a temperature of about 82° F. The air and spirit only come into contact once, and the low temperature at which the latter is maintained condenses it and prevents the operation resulting in the whisky losing aroma or flavor. There is said to be very little loss of strength. The time of working is four or five hours, according to the size of the plant and the quantity of spirit to be treated. The plant consists of ammonia compressor, condenser, refrigerator and spray vessel, driven by steam. An ingenious inventor, whose name has been closely connected with the production of ozone electrically, claimed, some years ago, to be able to produce adolescence in this popular beverage by submitting it to an ozonizing treatment, but we have not heard of any successful commercial results.

It is now three years and a half since the money bequeathed by Benjamin Franklin to the city of Boston for the benefit of its young workingmen became available under the terms of his will; that is, at the end of 100 years from his decease. The trustees of the fund, which now amounts to nearly $350,000, decided, after a prolonged controversy and much deliberation, and after the matter had been passed on by the courts and State legislature, to devote it to "the purchase of land and erection thereon of the Franklin Trades Schools and to the equipment of the same, under the direction of such department as may, for the time being, be charged by the statutes and ordinances with the duty of erecting and furnishing public buildings in the city of Boston." They paid the money to the city treasurer with this object, but no steps appear to have been taken toward beginning the work. Now it seems that the Franklin Fund is again to be submitted for the courts to adjudicate upon. A press dispatch from Boston says that it has been decided to apply to the Supreme Court for power to compel the city treasurer to pay over to the trustees that part of the fund in his possession, as, in the opinion of City Solicitor Babson, under the peculiar circumstances connected with the fund it is not regarded as safe to pay the money out of the city treasury to the trustees until the matter shall have been passed upon by the Supreme Court. It is unfortunate that so many delays should take place in the progress of the plan, for the establishment of such a trade school as that contemplated by the Franklin Fund trustees would be an immense benefit to Boston

SELECTED FORMULÆ.

Celery Compounds.—

Celery (seed ground)	25	parts.
Coca leaves (ground)	25	"
Black haw (ground)	25	"
Hyoscyamus leaves (ground)	12·5	"
Podophyllum (powdered)	10	"
Orange peel (ground)	6	"
Sugar (granulated)	400	"
Alcohol	150	"
Water, q. s. ad	400	"

Mix the alcohol with 150 parts of water and macerate drugs for 24 hours; pack in percolator and pour on menstruum till 340 parts is obtained; dissolve sugar in it and strain.—Bulletin of Pharmacy.

New and Brilliant Blacking.—A new and brilliant blacking for shoes, which has the advantage, furthermore, of being acid free, is thus described: Boil together for two hours 30 parts of powdered gall apples and 30 parts of rasped logwood in 200 parts of water. Strain off while hot; add 200 parts of sirup and 30 parts of iron sulphate in powder. Boil the liquid until it begins to thicken, and then add 10 parts of ruby shellac in 200 parts of alcohol.—Bulletin of Pharmacy.

Dyeing Leather.—We are placed in possession of the following particulars regarding the dyeing of leather through the courtesy of The Leather Manufacturer, of Boston: In dyeing leather, aniline or coal tar colors are generally used. These dyes, owing to their extremely rapid action on organic substances, such as leather, do not readily adapt themselves to the staining process, because a full brushful of dye liquor would give a much deeper coloration than a half exhausted brush would give. Consequently, to alter and to color leather by the staining process results in a patchy coloration of the skin. In the dyeing operation a zinc shallow trough, 4 to 6 inches deep, is used, into which the dye liquor is put, and to produce the best results the contents of the trough are kept at a uniform temperature by means of a heating apparatus beneath the trough, such as a gas jet or two, which readily allows of the heat being regulated. The skins to be dyed are spread out flat in the dye trough, one at a time, each skin remaining in the dye liquor the time prescribed by the recipe. The best coloration of the skin is produced by using three dye troughs of the same dye liquor, each of different strength, the skin being put in the weakest liquor first, then passed into the second, and from there into the third dye liquor, where it is allowed to remain until its full depth of color is obtained. Very great skill is required in the employment of aniline dyes, as if the heat be too great, or the skins remain too long in the final bath, "bronzing" of the color occurs. The only remedy for this (and that not always effectual) is to sponge the skin with plenty of cold, clean water, directly it is taken out of the final dye bath. The dyed skins are dried and finished as before.

LEATHER BROWN.

Extract of fustic	5	ounces.
Extract of hypernic	1	"
Extract of logwood	½	"
Water	2	gallons.

Boil all these ingredients for 15 minutes, and then dilute with water to make 10 gallons of dye liquor. Use the dye liquor at a temperature of 110° F.

As a Mordant.—Dissolve 3 ounces of white tartar and 1 ounces of alum in 10 gallons of water.

FAST BROWN.

Prepare a dye liquor by dissolving 1½ ounces fast brown in 1 gallon of water, and make a 10 gallon bulk of this. Use at a temperature of 110° F., and employ the same mordanting liquor as in last recipe.

BISMARCK BROWN.

Extract of fustic	4	ounces.
Extract of hypernic	1	"
Extract of logwood	½	"
Water	2	gallons.

Preparation.—Boil all together for 15 minutes.

Method of Dyeing.—First mordant the skins with a mordanting fluid made by dissolving 3 ounces tartar and ½ ounce borax in 10 gallons of water. Then put the skins into the above foundation bath at a temperature of 100° F. Take them out, and then put in 1 ounce of Bismarck brown, dissolved in boiling water. Put the skins in again until colored deep enough, then lift out, drip and dry.—American Druggist.

Toning Lantern Slides.—Th. J. Placzek, of Vienna (Photograph. Corresp.), gives the following directions for toning of collodion transparencies: If pyrogallic acid be used, instead of iron, for development, a pleasing blue black deposit results, that can be easily toned with neutral chloride of gold, chloride of palladium, etc., but the large addition of glacial acetic acid to the developer makes double the exposure necessary as compared with iron development. In consequence of this attempts have been made to tone the grayish-black image of iron developed positives, and the following bath has been found very useful:

Solution potassium chloroplatinite (1:50)	4 c. c.
Nitric acid	12 gtt.
Solution gold chloride (1:50)	3 c. c.
Water, distilled	(350 c. c. to) 600 "

The plates, after fixation with hyposulphite of sodium, or preferably cyanide of potassium, are well washed, and while still wet placed in the toning bath for one or two minutes. They acquire a blue-violet tone, which is found very suitable for lantern slides or stereoscopic transparencies. Dry collodion plates may also be toned in this bath, but the process is much slower, owing to the horny character of the collodion film, which resists the penetration of the solution. A bath of potassium chloroplatinite (1:1,400) slightly acidified with hydrochloric acid gives a blacker tone. A solution of

Water	500	parts.
Ammonium sulphocyanide	30	"
Sodium hyposulphite	½	"

added in equal quantity to the following:

Water	500	parts.
Solution gold chloride (1:50)	30 parts to 60	"

gives gray-blue tones. Platinum and gold toning is very successful with these baths.

[Continued from SUPPLEMENT, No. 1141, page 18236.]

THE FINDING OF THE REMAINS OF THE FOSSIL SLOTH AT BIG BONE CAVE, TENNESSEE, IN 1896.*

LONG before we had pulled the last bone out of the dust, our attention was attracted to the lower or older portion of the manure, which, owing to its peculiar consistency, I have called

FIG. 6.—SPECIMENS OF DISPLACED RUBBISH FOUND STUFFED INTO AND FILLING THE RAT HOLES.

1, 2 and 3, burnt sticks, pieces of charred cane, Arundinaria tecta, and charred hazel twig, Corylus americana, representing the ends of burnt out torches cast away by white men or Indians, often found at a greater depth in the layer than the sloth bones, having been intruded into the burrows from the surface by small animals.

LAYER 3.

(One foot thick.)

In it we observed no porcupine quills or tufts of fur, and for the reason below stated suspected that this lower subdivision of the dry excrement had become hardened and caked together just under the bones, into what it seemed reasonable to suppose had constituted the foothold of the cavern when the extinct animal appeared. Objects found in it, therefore, a further series of nuts, seeds, twigs, leaves, bat jaws, and fur described below, together with the dry carcass of the window fly, were to be reasonably regarded as older than the sloth.

FIG. 7.—RIB SHOWING SIGNS OF RODENT GNAWING, FOUND IN LAYER 2.

How may we better account for the character and position of this crust than by supposing that it represented that portion of the once lower floor where the carcass of the animal had for a time rested and into which the juices had filtered, caking together the coprolites during the consumption of the flesh by rats and porcupines?

This not improbable suspicion was strengthened when we considered the number of bones found at the spot, not simply the twelve exhumed by us, but those previously excavated by Priest and Johnson, now in Prof. Safford's possession, and we may add the eighteen other remarkable cartilaginous specimens, presumably from the same spot, at the Academy of Natural Sciences. If the whole combined series fails to duplicate or contradict the construction of a single fossil sloth skeleton, then all, because all indicate a young animal, and because all show cartilage as no other sloth bones elsewhere found have yet done, can be reasonably referred to the same individual animal. Many other bones, originally near or upon the surface, may have been removed by Indians or carried away by saltpeter diggers and lost. Rats may have made off with others. And, notwithstanding the fact that the sets belonging to the Academy and Prof. Safford, together with my specimens, may fail to reconstruct the animal's skeleton, the three sets together include enough bones to indicate that the creature had once lain there in the flesh. Because the tooth marks seem to refer to the work never of carnivora, but always of rodents, less to the efforts of large than of small animals not strong enough to have carried a skull such as Priest found, or a scapula like that at the Academy, from any other resting place in the cave, it seems reasonable to suppose that the bones reached their position by the most natural of agencies, that the sloth, lost or overcome by sickness in the darkness, had lain down to die at the place in question.

Reasonably doubting that it had shambled into the cave after the helpless club-footed manner of the modern ai or unau, shall we speculate further and imagine that the animal, less clumsy and sluggish than its modern South American relatives and presumably herbivorous from the structure of its teeth, was attracted to the spot by the smell of grass and leaves, brought thither by porcupines and rats? If not, we must believe that its choice of a deathbed in the only rat den in that part of the cave was a coincidence. But, however the position of the bones is to be accounted for, let us believe that if the carcass lay upon the manure, the number of visiting omnivorous rodents increased until the process of devouring the flesh had been succeeded by the gnawing of the bones.

If these suggestions explain how the bones came to be where we found them, we next ask, How old are they? When did they reach their position? An inquiry above all depending upon the study of the objects dug out of the earth with them. These are to be divided into three classes: First, objects of later age than the bones, or of doubtful antiquity; second, objects as old as the bones; and third, objects older than the bones. To the first class belong the torch ends of cane, Arundinaria tecta, hazel; fragments of clay, coprolites and bits of charcoal, mentioned above, as belonging to Layer 1, and second, objects artificially intruded into Layer 2.

OBJECTS OF LATER AGE THAN THE BONES OR OF DOUBTFUL ANTIQUITY.

The hoarding habit of the underground rat had helped our investigation at Big Bone Cave, but his burrowing perplexed and vexed us, confronting us with one of the dangers that often threaten exact observation in caves. The slowly formed accumulation of dry excrement had been undermined and disturbed by the tunneling of its makers against the right and left walls, where several rat holes were revealed by a variation in the texture of the neighboring layer. Pushed and wadded into these burrows (see Fig. 6) we found a bunch of moss, Hypnum; ten twigs from three to eight inches long, charred at the ends and evidently the remnants of torches used by Indians or white men; of the hazel, Corylus americana; five fragments, one of them charred and three inches long, of resinous yellow pine, Pinus mitis; a fragment of charred cane stalk, Arundinaria macrosperma, and another twig about eight inches long, not burned, of the cane, Arundinaria tecta; a gnawed pig nut, Hicoria glabra, and a shell bark, Hicoria ovata; a piece of hickory nut, Hicoria minima; a chokecherry stone, Prunus virginiana Linn.; a piece of hazel nut, Corylus americana; a fragment of an

* Abstract of paper by Henry C. Mercer, curator of the Museum of American and Prehistoric Archæology at the University of Pennsylvania, read before the American Philosophical Society.

acorn of the pin oak, Quercus palustris, and three pieces of winged seeds of the blue ash, Fraxinus quadrangulata, besides a piece of bark, probably hazel, and fragments of unidentified grass and bark. Besides these botanical specimens kindly identified (with all others referred to in this paper) by Mr. Stewardson Brown, of the Academy of Natural Sciences, of Philadelphia, Mr. S. N. Rhoads and Dr. Harrison Allen, of the Academy, have further settled the identity of twenty quills of the porcupine, Erethizon dorsatus, with its numerous excrements, and a piece of hair which had found their way into the holes, besides the upper jaw with portions of the skull of a bat, Vespertilio gryphus; and a lower and upper jaw, with teeth and cartilage attached, of a larger bat, Adelonycteris fusca. More excrements of porcupine seemed to have worked into the choked-up holes than were observed in the undisturbed portion of the layer, while with them was found a fragment of the brain case of a large mammal, smaller, according to Mr. Rhoads, than an adult bear. If this small specimen, not an inch in length, cannot be regarded as a portion of the remains of the megalonyx, it represents the only trace of any other large animal that we, or our guides previously, were able to find at the spot. But the objects found in the rat holes could not reasonably be associated with the bones. Though positively testifying to the presence of men as well as of animals in the cave, the charred torch sticks and other articles had been transported from their original position in the manure; and while it was certain that objects found in the superficial Layer 1 were more modern than the sloth bones, the rat hole specimens had lost their true time relation to the sloth. If not all intruded downward from above, and so presumably more modern than the bones, the collective age of all the specimens was doubtful and offered no evidence of the contemporaneity of man and the megalonyx.

On the other hand, no sign of disturbance was presented by the texture or contents of the middle portion of Layer 2. There the objects found at various points, and particularly close to the bones, seemed fairly to be regarded as ingredients of the deposit. Undoubtedly they represented plants and animals in existence at the time the bones had been deposited.

As we dug on with shovel, hands and trowels, narrowly observing that part of the manure (in many cases preserved by us in bags) lying in immediate contact with the bones, our work revealed by reasonable inference a series of

OBJECTS AS OLD AS THE BONES.

In the handfuls of refuse removed from close proximity to the sloth bones and preserved in bags were found, as identified by Mr. Rhoads (see Fig. 8) numerous tufts of the fur (also found in the rat holes), a com-

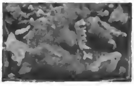


FIG. 8.

Mass of felted hair of rodents, together with a fine wool belonging possibly to the extinct sloth, found scattered through Layer 2, and often near the large bones. On this lies a jaw from the same layer of the bat, Adelonycteris fusca. The background shows the mass of rat manure and clay fragments characteristic of Layer 2. (Actual size.)

paratively large excrement quite unlike the other coprolites in size and shape, attributed by Mr. Rhoads to an herbivorous animal. Of the common coprolites previously mentioned, the larger and scarcer ones, containing fine shining particles of undigested hulls and skins of nuts, showed that the porcupine (Erethizon dorsatus), guided by other senses than sight, had been continually present during the formation of Layer 2. So testified a hair from the back of one of these animals (Fig. 7, object 16).

Eight beautifully preserved minute jaws and several little bones were identified by Dr. Harrison Allen as the remains of two kinds of still existing bats, Adelonycteris fusca (see Fig. 7, objects 17), and the smaller Vespertilio gryphus. Unfossilized and fresh looking, the bones, according to Dr. Allen, represent individuals which had fluttered through the congenial blackness of the gallery in geologically recent times, though we admit that the species referred to are ancient and probably existed at the epoch called post glacial.

In the very close neighborhood of the bones, as further identified by Mr. Stewardson Brown, we found fragments of the acorns of the red oak, Quercus rubra Linn. (Fig. 7, object 5), and of the white oak, Quercus alba Linn.; an acorn cup of the pin oak, Quercus palustris Duke; half of a nut gnawed by rodents of the thick-shelled, small-kerneled mocker nut, Hicoria alba Linn., Br.; several gnawed nuts of shellbark, Hicoria ovata Mill. Br.; and the gnawed nut of the butter nut, Juglans cinerea (Linn.). With these lay several fragments of winged seeds of blue ash, Fraxinus quadrangulata Mich. (see Fig. 7, object 4); two seeds of the horn beam, Fraxinus caroliniana Walt.; a piece of bark of the chokecherry; a seed of the gum Nyssa sylvatica; two small twigs of dogwood, Cornus alternifolia Linn.; fourteen little fragments of sticks and leaves and several pieces of bark undetermined, together with two wild cherry stones, Prunus pennsylvanica Linn.; while recorded as exactly under one of the sloth bones we pulled out a seed of the alder, Alnus incana Linn., and another of the horn beam, Carpinus caroliniana Walt., with a nut of the beech, Fagus americana Sweet.

There was no reason for doubting that these objects had reached their position at or about the time of the deposition of the sloth bones. Many of the nuts had been gnawed by cave rats (see Fig. 7, object 9), Neotoma magister, and the same agile pilfering animal, helped possibly by the porcupine, had doubtless dragged in by way of the roof holes, whether for nest building, for food, or in pursuance of its eccentric hoarding habits, many of the other objects scattered at various points in Layer 2. In this mass of excrements of the cave rat, [illegible] as they were, were crushed with some difficulty between the thumb and finger, together with the lesser porcupine coprolites, we found a hair from the back of the porcupine and a portion of the right side of the upper jaw with molar teeth of the cave rat (see Fig. 7, objects 16 and 15). Scattered irregularly through the layer as identified by Mr. Thomas Meehan and Mr. Brown lay an acorn cup of the Spanish oak, Quercus digitata (Marsh) Sud.; two fragments of acorns of the pin oak, Quercus palustris; a seed of the horn beam, Carpinus caroliniana Walt; and fragments of seed of the blue ash, Fraxinus quadrangulata Mx.; a fragment of hickory nut, Hicoria minima; of hazel nut, Corylus americana Walt. (see Fig. 7, object 18), and of beech nut, Fagus americana Sweet; a valve of the hop horn beam, Ostrya virginica Willd.; an awn of wild rye or lyme grass, Elymus Linn.; and a piece of the stipe of common brake, probably Pteris aquelina Linn. With these were two seeds of the blue ash, Fraxinus quadrangulata, others of the horn beam, Carpinus caroliniana, alder, Alnus incana, beech, Fagus americana, and gum, Nyssa sylvatica, two wild cherry stones, Prunus pennsylvanicus, a piece of chokecherry bark, twigs of dogwood, Cornus alternifolia, fragments of sticks (see Fig. 7, object 10) and leaves, and, according to Prof. Heilprin, one of the beadlike stem segments of a crinoid characteristic of the carboniferous limestone of the cave walls.

Judged by this botanical association, the age of the sloth remains was that of the flora of the surrounding hills, and that had not changed since seeds, nuts and bones came together. These specimens of well known trees and plants common to the forest of eastern North America still flourished upon the mountain above us.

But over and above the general significance of this fact, two objects discovered—the fur and the large coprolite—had a particular bearing upon the investigation.

Sometimes close to the bones, and generally scattered through the whole mass of manure in Layer 2, felted like tufts of carpet dust in an unswept room, lay wads of hair or fur (see Fig. 8, Fig. 4, object 4, and Fig. 7, object 14), exceedingly fine, slightly crinkled, with a reddish brown color, possibly due to contact with the cave earth. To what animal shall we attribute them? Certain fine bits may, according to Mr. Rhoads, be referred to the bat and a few straight hairs to the rat or porcupine. But as none of the rat fur has this crinkle, and as the under fur of the porcupine, according to Mr. Rhoads, is coarser than these specimens and always straight, this crinkled cave wool is attributable to neither animal. Shall we suppose it to be the under fur of the buffalo, or of any of the animals of the outer forest carried down into the cave in predominant quantity by rats? Is it sloth fur, and if so, why its extreme fineness? Where are the large, limp hairs, flattened in appearance and grayish white in color, characteristic of the living sloths? Shall we fancy the fossil sloth fine-furred as a seal? Yet if this discovered fur, which in all reason is contemporary with the sloth bones, be not sloth fur, what became of the sloth fur if the animal, as we suppose, perished here?

Leaving the significance of the fur in doubt, we are left to account for the comparatively large excrement of a herbivorous animal, likewise found in Layer 2, and altogether too large for the porcupine or cave rat (see Fig. 7, object 8, and Fig. 4, object 3). Because no other trace of a herbivorous animal of the size indicated was observed at the spot, and because of the herbivorous character of the sloth itself, it has seemed to Mr. Rhoads and myself possible to refer it, modern as it looks, to the latter mammal rather than to the exceptional presence of any other grass-eating creature at that part of the cave. On the other hand, it appears small for the great sloth, while its unbroken contours infer that it must have been transported when dry and hard, if we are to ascribe it to the deer or any animal of the outer forest, and suppose that the hoarding rat carried it down the roof holes into the cave.

In the compact lower portion of the manure, called Layer 3, forming, as before described, a crust suggestive of an older floor immediately under the bones, we found what by a reasonable inference were regarded as

OBJECTS OLDER THAN THE BONES.

Here in the dense mass of rat excrement rested a lower jaw of the bat, Adelonycteris fusca (see Fig. 9, object 7), as to which, in completing the list of bat remains found in the cave, Dr. Allen says that the bats here described seem larger than our common Eastern forms, though no marked variation in bats has been observed since the Pleistocene. Not far from this, and as kindly identified by Mr. C. M. Johnson, of the Wagner Institute, lay a well preserved dry carcass of the small "window" fly, common in the United States, first described in America by Say in 1828, as a new species, Scenopinus pallipes, but afterward recognized as identical with the European Scenopinus fenestralis Linn., the window-haunting adult insect of the so-called carpet worm. Entomologists have left us in doubt as to its life and habits, but we may suppose that its food quest led it so far underground as a consumer either of decayed wood, of dried woolly or animal matter (like carpets, under which its thin larvæ are often found), or, according to Williston, of the minute tineidæ, or the true wool-devouring moths, psocidæ, who would have attended the decomposition of animal skins and furs at the spot. However the fly's visit to the subterranean darkness is to be accounted for, there can be little doubt that it came down through the roof holes like the cricket above mentioned, while its position at this depth in the cave refuse would testify to its presence in America before the coming of Columbus, were entomologists not sufficiently sure that it had not followed the white discoverers in their ships across the Atlantic.

Near by were found bedded in Layer 3 small pieces of bark, nuts, grass, twigs and plant fiber unidentified, pieces of horn beam seed, Carpinus caroliniana (see Fig. 9, object 5); a seed of the blue ash, Fraxinus quadrangulata; two shellbarks, Hicoria ovata, and four fragments well gnawed by rodents; a gnawed bitternut, Hicoria minima, showing orifices for extracting the kernel made by a small rodent; and six pieces of the acorn of the pin oak, Quercus palustris (for all of which see Fig. 9). Judging by the absence of quills, hairs and coprolites, the porcupine had not visited the cave during the formation of Layer 3. Neither were we able to find in the latter layer the wads of fine fur so characteristic of Layer 2 above it; but if these were specimens of sloth fur, their absence is what we might have expected, since the fur of the sloth could not well have been scattered over a lower depth than the resting place of its carcass. The absence of these ingredients, these differences in character, together with its position, were sufficient to assign an older date to the lower layer, whether its crusted consistency was due to infiltration of animal matter or not. According to the order of formation of the different refuse, the lower layer preceded the upper, and the gnawed nuts, the seeds, thus ily preserving intact its delicate wings, comparatively modern as they seemed, had reached their position before the deposition of the bones.

Faint from continual inhalation of the noxious dust, we had lost the energy to excavate to its bottom, the last and lowest layer,

LAYER 4

(Depth unknown),

a mass of fine water-laid clay, broken in lumps ranging in size from six inches to a quarter of an inch in diameter, covering the whole floor of the gallery and evidently the equivalent of the nitrous earth which had been elsewhere removed. By their laminated structure the lumps gave evidence of their aqueous deposition, while hard as they now were, they dissolved immediately on immersion in water. Some pieces showed an irregular texture as of the caking together of various partially hardened muds, while others, in the opinion of Mr. George Vaux, Jr., revealed small fragments (irreducible by boiling in water) of adulterated carbonate of lime, probably aragonite. After digging several holes in the mass to learn that the manure had infiltrated downward for at least two feet through its interstices, we abandoned it where the configuration of the cave walls, widening as we went down into a crevice of unknown depth (see Fig. 3), rendered further work under the circumstances hopeless. We left with the reasonable inference that a depth of five, ten or fifteen feet would have laid bare the whole bottom, as it had been laid bare elsewhere in the gallery. Doubtless the process of drying, which succeeded the deposition of the layer by water, had broken it into lumps, between which the upper refuse, as remarked before, had penetrated, thus adulterating it without obscuring the fact that in its true constitution, for the eighteen inches examined, it contained no trace of man or animals.

Allowing the dust to settle for the last time, we turned away from the mysterious spot, and, threading

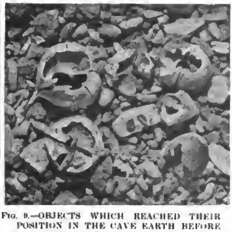


FIG. 9.—OBJECTS WHICH REACHED THEIR POSITION IN THE CAVE EARTH BEFORE THE ADVENT OF THE SLOTH BONES (Actual size.)

our way wearily through the chilly gallery, came with sudden shock upon the dazzling glow and severe heat of a Southern evening. With difficulty we toiled homeward, resting often in the warm woods.

At the last remaining point of significance we had examined layers which probably present all the evidence that will ever be collected as to the antiquity of the fossil sloth of Big Bone Cave.

Let paleontology enlighten us as to the probable character and habits of this animal, which we must reasonably regard as one of the common inhabitants of the American forest in Pleistocene times. Comparing the large vertebræ, the skull, the proportionately shorter claws and stouter limbs with the skeletons of the existing South American sloths, as here shown (thanks to the kindness of Dr. R. C. Chapman), we may well disbelieve that this animal hung, like the latter, back downward for days upon a single bough, or lagged in one tree or grove until moss formed upon its fur. How shall we imagine the creature, weighing from twelve to sixteen hundred pounds, moving from tree top to tree top in any known North American forest, when on the blowing of wind, according to the saying in Brazil, sloths travel. On the contrary, as the continual falling of so large an animal by the breaking of boughs is not to be imagined, we must deny the creature a strictly arboreal life, rather supposing, with Prof. Cope, that the boughs came down to the sloth than that the sloth went up to the boughs. In place of moss-covered clumps of motionless fur not easily distinguished from leaves, that a keen eye recognizes in South American tree tops, we fancy animals inhabiting the earth and proclaiming their presence by the crash of saplings and outlying boughs, as, rising upon their hind legs or climbing to the forks of heavy trunks, they tear their fodder to the ground.

If they despised water, like the ai and unau, they licked salt, as their fossil bones bedded in the Petit Anse salt pit in Louisiana and the mire of Big Bone Lick testify. As terrestrial animals continually on the defensive against the foes of the forest, probably little less active than bears, the great sloths would hardly have rolled helplessly upon their backs when attacked like the unau or yielded up their dinner with a melancholy drone. On the contrary, though we must imagine them inoffensive and by no means agressive

enemies of animals or man, the thrust of the powerful arm, and scratch with the claws that brought down saplings, might well have defended them against powerful and active foes.

A categorical demonstration that this individual animal was a contemporary of the geologically recent Indian in Tennessee must be abandoned. But the reasonable inference of such association remains. Though the human handiwork, in the form of charcoal and torch refuse (except the rat hole specimens), lay really on the surface (Layer 1) from six inches to one foot above any sloth bone found; we may justly be satisfied with the recent significance, broadly regarded, of the whole record, and with the absence of plants and smaller animals of any extinct or positively ancient form.

Gradually a thin sprinkling of rat excrement upon the clay floor had thickened into a dry, dense mass. Before the deposit had reached a depth of two feet the sloth had appeared and perished, and while the duration of this manure-making process, which finally, rising round the bones, covered them to a depth of one foot or eighteen inches, cannot be safely guessed at in terms of centuries, there can be no doubt that it is geologically recent, and that its construction which preceded and followed the deposition of the sloth bones is continued by the visits of existing cave rats at the present day. The manure formed, the leaves, nuts, grass and seeds found their way in, without the interruption of any important interval of time or geological event changing the topography of the cavern. The roof holes had probably remained open continuously. The subterranean temperature of fifty-five degrees Fahrenheit, with an extreme dryness, had probably persisted. The same flora had continued to flourish upon the mountain. The same visiting animals had continued to find the same plant food, while the same bat species had sailed in from the open entrance.

Had these bones lain within reach of the percolating chloride of lime, this mineral, filling the cavities vacated by animal matter, might have hardened them as cave bones are often hardened, but lying where we found them, we may well doubt whether they ever would have fossilized. Under such circumstances, let us believe that a nut, a seed, a leaf, or even a fly, would preserve the freshness of its structure for a long time, and hence that the interesting remains found with the bones may not be so modern as they seem. With this reservation, and without attempting to deal definitely with dates, it seems safe to class the evidence not only as geologically but as historically recent. Not more ancient in appearance, not more brittle than the bones of animals found by me in the Indian midden heaps of several caves, the position of the bones in the upper and later part of the rubbish, their gnawed condition and their association, as described above, offer nowhere a suggestion of great antiquity. Separated from all association with the remains of other Pleistocene animals, they fail to lend the color of antiquity to the situation. On the contrary, like the peccary bones found at Durham Cave, like the remains of tapir and mylodon discovered in Lookout Cavern, they seem modernized by their surroundings. Let us infer that we have found a species which, long surviving its day and earlier relationship, had become an anomaly; that we have modernized the fossil sloth, if we have not definitely increased the antiquity of the Indian hunter, whose first coming the animal doubtless witnessed in the woods of Tennessee.

THE LIORET PHONOGRAPH.

At the end of May we entered a vast court lined with five story houses in Rue Thibaud, just beyond the Luxembourg. Every one was at the windows listening to a speech delivered in a loud voice that was somewhat too measured to suggest that of an open air orator. We listened to this sonorous voice, but looked for the orator in vain. Finally, at the back of the court, we perceived what seemed to be a small stage covered with a red carpet. He is there, we thought, and so we went forward.

The stage changed its aspect; there was a tripod half hidden by red velvet upon which was placed a sort of casket, and, in front, a large trumpet of polished metal. It was superfluous to look further; the orator was a phonograph, and such a one as we had never before heard. The Edison phonograph and its successors are certainly very extraordinary, but with these it is necessary to approach the instrument and place the ends of a tube in the ears in order to hear, or else stand a few feet distant from a trumpet that distributes the sounds. This time, it is a very different thing. The voice is distinctly heard in the open air, at a distance of twenty-five yards, with its pretty nearly natural timbre. The illusion is complete. One would affirm that it was really some one who was speaking, and who was inflating his voice in order to increase its range. Every one, in the course of his life, has heard a speech on the occasion of the inauguration of a statue or of some other public ceremony. Such was the speech delivered in the court. And the illusion was rendered the more perfect by the noisy applause that broke forth from all the windows of the houses. It is to M. Lioret that is due the credit of having rendered the phonograph truly practical.

The Lioret phonograph, which is very simple in construction, possesses an intensity of sound that has never before been obtained, and, when everything works well, the articulation is extremely clear and the timbre relatively good; and the apparatus lends itself faithfully to all reproductions—speeches, operas, operettas, duos, trios, military marches, etc.

Scarcely had the phonograph ceased its speech in Rue Thibaud, when we suddenly heard the beating of drums and a blast of clarions. Then came a player of the biniou (a sort of bagpipe), an air on a hautbois, etc. Music boxes are now done for, since hereafter every one will be able to have at home the singers that he prefers and to hear operas and comic operas executed. The apparatus is at present capable of operating for more than five minutes, and, by means of a very simple artifice, for more than an hour. We shall therefore be able to hear an entire act, just as with the theatrophone.

The apparatus consists of the following parts. A tripod like that of a camera, which is concealed by a beautiful cover, and upon which is placed the apparatus provided with a large sonorous trumpet. The celluloid rollers, which are a few inches in length, are inclosed in a morocco leather box. Each roller carries the preferred morceau condensed into a few fractions of an inch, and corresponds to the old perforated band of the pianista. The roller is adjusted upon the apparatus, one pushes a button, and, presto! perceives almost the respiration of the singer.

The apparatus can be folded up and taken on a moonlight night to a park and be installed under the trees and amid flowers in order to allow the phonograph to reproduce the voices of our most celebrated artists. We have heard "La Dame Blanche" in a park, with a violin, violoncello, etc., accompaniment. This does not happen every day, even in the country.

This new instrument is truly curious, because the intensity of the sounds is such that it may be concealed in a corner, and give the illusion of a person speaking at a distance. It was recently operated in a garden at Ville d'Avray, where it caused a crowd to gather at the gates, and passers-by asked again and again where the singers were.

Such, in brief, are the effects of the new phonograph; and now for a few descriptive details.

The principle is well known: A person speaks or sings before a thin disk that is capable of vibrating and is provided with a point in the center. The voice causes the disk to vibrate, and the point traces fine lines upon a roller of soft material which is made to revolve very regularly. This is the registering part. Reciprocally, when the roller is made to revolve in the same way before a point fixed to a vibrating disk, the sounds are reproduced integrally. The improvements due to M. Lioret are important. They concern the movement, the motor, the transmission of motion, the cylinder, the resonator and the amplifying trumpet.

The movement that carries along the roller must be extremely regular. This is produced by a very accurate piece of clockwork, which, as a general thing, is actuated by a 13 pound weight suspended from a pitch chain that runs over a barrel fixed to a toothed wheel of large diameter that controls the revolution. The movement is further regulated by a small fly wheel of which the wings open out and give so much the more resistance in the air in proportion as the revolution tends to quicken. Upon the fly wheel a small piece of rubber fixed to the end of a lever acts as a brake. Upon depressing the lever, the fly wheel is set free and begins to revolve. The apparatus is thus set in operation.

Upon the side there is a small rubber band which connects two wooden pulleys and transmits the motion. This band constitutes one of the characteristics of the new apparatus. It is a transmission belt which prevents any vibration of the apparatus that might affect the revolution of the roller and be communicated to the resonator.

The vibrating disk is very wide and is set into a sort of flat box forming a resonator. The trumpet is fixed to the latter. Finally, the point of the style that enters the grooves in the roller is of sapphire, and, consequently, very hard. M. Lioret, who is making continuous researches with a view to improving his apparatus, has recently modified this point, and given it a new form. It is no longer a sharp point, but a rounded one. The effect of this change is important.

The trumpet whence the sounds proceed has also been modified. Toward the middle of its length, in an aperture formed in the side, there is fixed a small piece of metal by means of a screw. This simple addition gives an extraordinary result, the intensity of the sound being thereby nearly doubled and the clearness of the emission very much increased. Finally, when it is desired to operate the apparatus in a large auditorium, the amplitude of the sounds and the clearness of the articulation may be further increased. M. Lioret places in front of the first trumpet a second and larger one of thin metal and in the form of a truncated cone. The effect is singular. The range of the sounds is immediately tripled and the words reach the ear with remarkable clearness. This fact has been proved at the Trocadero, where the acoustics of the hall are pretty bad, but where, nevertheless, a phonograph placed upon the stage has been heard perfectly from all parts.

One word more as to the rollers. M. Lioret makes these of celluloid. This is an advantage, since wax rollers become soft through heat and are put out of service by a fall or almost any slight accident. With celluloid, it is possible for every roller to last a century. A fall does not harm it, since it is solid.

The apparatus, it is true, is not reversible, that is to say, it is impossible, as in the old phonographs, for a person to register songs and speech for himself. The rollers have to be procured already prepared, and none but these can be used in the apparatus. The difficulty might be overcome if the inventor desired it, but it is very evident that he does not care to do so. He prefers to sell his rollers, and it is thus certain that they are properly registered.

Upon the proper manufacture of the rollers evidently depends the success of the operation of the apparatus. The manufacture, moreover, is interesting. The celluloid is softened by a secret process, and then, in the form of a roller, is turned and polished with the greatest care. The roller thus worked is carried by an axis to which is given an absolutely regular rotary and

Fig. 1.—EXHIBITION OF THE LIORET PHONOGRAPH IN THE LARGE HALL OF THE TROCADERO

Fig. 2.—GENERAL VIEW OF THE PHONOGRAPH.

Fig. 3.—DETAILS OF THE POINT AND REGISTERING CYLINDER.

horizontal motion produced by a dynamo. A singer places himself in front of a trumpet, which directs his voice upon a vibrating disk of which every motion is followed by a graver. This latter penetrates the softened celluloid and produces therein depressions that are almost invisible and that will be used by the phonograph for reproduction.—La Nature.

APPLICATION OF ELECTRICITY TO RAILROADS NOW OPERATED BY STEAM POWER.*

By N. H. HEFT.

THE New York, New Haven and Hartford Railroad Company owns and controls about 2,800 miles of main line railroad track in New York, Massachusetts, Rhode Island and Connecticut, of which about 16 miles are operated by electricity on the third rail system and 14 miles on the overhead trolley system.

The first line to be equipped by the New Haven Company was a purely summer road, operated about four months in the year only, through a narrow peninsula running out from the mainland on the Massachusetts coast from Nantasket Junction to Pemberton, a distance of about 7 miles of double track. This line was chosen partly because the main line operation would not be interfered with in case of trouble with the electric trains, and partly because of the existing heavy summer traffic, which would put the new apparatus and the feasibility of the entire system to a severe test. An overhead trolley line was built, with center pole construction, and everything made very strong and more substantial than was at that time found in any street railway work, to our knowledge.

The line was operated for the first summer with excellent success, and all fear of trouble having disappeared, an extension of 3·6 miles was made on the main line of the company's Plymouth Division, this section being operated by the third rail system.

In December, 1896, we commenced work on a new line running from Berlin, Conn., through New Britain to Hartford, a distance of 12·3 miles, 3 of which, from Berlin to New Britain, is a double track, and the remainder, from New Britain to Hartford, a single track. A power station was built at Berlin, one end of this line, partly because of a desire to test transmission of power to a considerable distance and partly because Berlin is the center of several radiating lines, which may eventually be put into operation by electricity.

We have learned very thoroughly, in our street railway experience, the lesson of the importance to any transportation agency, working in a thickly populated territory, of uniform fares and a frequent and regular train service—of a train service which requires no printed schedule to enable people to know when cars may be found in waiting.

On its Nantasket Beach line the New Haven Company gave, during the last summer, a regular half hour service from 6:30 in the morning until 11:30 at night. The fares charged on the Nantasket Beach line before the advent of electricity were 10 cents from Pemberton to Nantasket and 18 cents from Nantasket to East Weymouth, a total of 28 cents from Pemberton to East Weymouth. With electric traction they have been placed at a uniform rate of 5 cents from Pemberton to Nantasket and 5 cents from Nantasket to East Weymouth, a total of 10 cents from Pemberton to East Weymouth. Under these new conditions the traffic has increased enormously on this line; the summer of 1895, the first of the electrical operation, showing an increase of 92·6 per cent. over the previous summer in the number of passengers carried; the summer of 1896 showing 45·1 per cent. increase over 1895, while in the summer just passed we have carried nearly three times as many passengers as in the last year of steam operation.

The operation of the line from New Britain to Hartford was commenced in May last, with a regular half-hour train schedule from 6 in the morning to 11:30 at night, and with a uniform fare of 10 cents each way, instead of 28 cents, the former charge. The electric line carries through passengers only between Hartford and New Britain, the passengers for the five way-stations being carried by the regular steam trains running on a parallel track. For ordinary everyday service a single open-motor car was used during the past summer, while for extra loads light double-truck trail cars seating seventy people were attached. On rainy days a standard close passenger coach was hauled by the open-motor car. On holidays and Sundays the cars pulled two trailers, the entire train seating nearly 250 passengers. About the middle of August steam service on the Berlin-New Britain branch was discontinued, and the traffic has since been handled entirely by electricity. Sixteen trains each way per day are run, connecting with steam trains.

Under the conditions named on the Hartford-New Britain line we have carried during the three summer months 400 per cent. more passengers than we carried through the corresponding months of last year.

I do not suppose that any but a trained railroad man can understand the impossibility of operating trains and maintaining schedules by steam locomotives in the way that has been done by electricity at Nantasket Beach last summer. There are a great many curves on the line and several grades. There are no excessively sharp curvatures or steep grades, and it is not here that the trouble has come. The difficulty is found in the fact that there are no less than seventeen stations on a line only 10·6 miles in length, or an average distance between stations of but about 0·6 of a mile. To make a run of 10 miles with sixteen stops in twenty-six minutes; to be obliged to do this in order to connect with boats arriving at regular half-hour intervals, and to keep out of the way of frequent regular steam trains on the main line of the Plymouth Division; to allow but four minutes at each end for unloading, switching (including running around trail car), and loading, and to do this day in and day out, in regular service, through an entire summer—these are things which cannot possibly be accomplished by steam locomotives.

Now the reason why electricity can do this and steam cannot is found in the tremendous accelerating power of properly designed electric motors, with rotary motion, as compared with reciprocal motion of steam locomotives. A 60 ton train, for example, in running from Windermere to Allerton, a distance of only 1,800 feet, reaches a maximum speed of 31 miles per hour, while in the longer run from Power Station to Nantasket Junction, a distance still of but 5,808 feet, a maximum speed of 30 miles is reached. The entire distance is covered, in regular service, at an average speed of 24·6 miles per hour, including stops.

Between Hartford and New Britain the 9·3 miles distance is covered regularly by motor cars with two trailers in from 18 to 20 minutes, an average speed of from 28 to 30 miles per hour, while, with a special high-geared motor, a maximum speed of over 60 miles has been made, the entire distance of 9·3 miles being covered in ten minutes. On this line a 52 ton train often reaches a maximum speed of 50 miles per hour. The current is cut off at twenty-nine grade crossings when single-car trains are run.

It is worthy of note, in this connection, that the line between New Britain and Hartford is in direct competition with a trolley line between the same points, but following a more circuitous route. The schedule time of trolley cars is fifty-five minutes, as against our time of less than twenty minutes, and the rate of fare is 15 cents (including a transfer given for use on the street railways of either city), as against ours of 10 cents for the straight run between the two cities only. The ownership of right of way has a very important influence upon speed and competitive conditions under circumstances like these.

The type of car selected for any good transportation service has a direct bearing upon the development of traffic and maximum gross receipts. It has been difficult for steam railroads to depart far from the long established custom of closed passenger coaches of the present standard type, and to adopt open cars, on account of the disagreeable effect on passengers of the smoke and gases from engines. This has naturally thrown a great deal of traffic to competing street railway lines running open cars in summer, on account of the greater comfort of the open car.

With electric operation open cars in heavy railroad practice are possible, even at considerable speed, particularly if the front of the car is closed in with glass, and both at Nantasket Beach and on the Hartford-Berlin line we have used heavy open cars with great success.

The motor car, which we have so far used, we do not consider, by any means, the final type, and even now we have in mind plans of combination cars which we believe will be, on the whole, well adapted for railroad work. The present motor car is very heavily built, with floors of a height equal to that of our standard passenger coaches. It contains sixteen cross seats, capable of seating ninety-six passengers, and the entrance is from either side, with three steps. Each car has two heavy railroad trucks, one of which is equipped with two 125 horse power motors. The total weight of the motor car is thirty-two tons, and the trailer car of the same type weighs twenty-five tons. The motors which we have used up to date have been of a type common in heavy elevated railway work. These motors have often been in service for several consecutive days, making 325 miles each day, without apparent injury. We found the motors we are using already in the market when we commenced our experiments, and, until recently, no attempt has been made by us to specify changes. The experience gained with these motors has served as a basis for building larger and heavier types, better adapted for the severe work which they will be called upon to fulfill to meet our requirements. An important point which we shall specify in new motors is that they shall have the most perfect ventilation possible. The efforts of manufacturers have been hitherto directed toward completely incasing the motors, so as to make them waterproof, but in doing this ventilation has been sacrificed.

We have found it beneficial to blow out our motors several times during the day by means of a blast of air from a hose pipe connected to our air brake reservoir, but this is, at best, but a makeshift.

It is very difficult to dispose of all the necessary cables, wires, brake rods and chains, air brake cylinders and apparatus, switches and other car controlling mechanism in the limited space beneath the car floor, as may be readily imagined by those familiar with street railway work. As a consequence, there has always been more or less controversy between those responsible for the placing of the different portions of the equipment as to who shall have the first right to a given space, perhaps hardly a half a dozen square inches in section. There is also more or less trouble with abraded wires, short-circuited shoe hangers, etc., and for our future work we are making an effort to simplify this mass of equipment mechanism by putting some of it, particularly the wires and cables, in a space between the true floor of the car and a false floor several inches below, specially provided for the purpose.

For operating heavy trains of this character, where currents of from 300 to 1,000 amperes are sometimes used, the controlling apparatus must be massive and strong in every part, and the greatest care must be taken to prevent arcing. We have had no trouble with controlling apparatus on our regular equipments, and we consider this branch of the apparatus well perfected.

The danger to station and car apparatus from lightning discharges, which is so important a factor in street railroading where the overhead system is employed, is avoided in third-rail work, since the third rail is so close to the ground that it is practically a lightning arrester itself throughout its whole length.

The problem of braking, which is so important in street railroading, is even more so with us, since the train weights and speeds are enormously greater. The regular Westinghouse air brake system, with engineer's valve, is used on our electric trains, but instead of steam air compressors we have an electric motor compressor, controlled by an automatic regulator which has given excellent satisfaction.

Our experience with trolleys on the overhead line at Nantasket Beach, originally put in two years ago, has not been satisfactory. We find it quite impossible to prevent the destruction of trolley wheels by almost continual arcing when attempting to take from the wire the heavy current required in starting and during acceleration, as well as the smaller currents taken at the maximum speed. There has been a good deal of trouble, moreover, in keeping the trolleys on the wire in making speed and taking curves, and many trolley poles have been broken. The trolley difficulties have not interfered with the continuous operation of our line, but the cost of replacing wheels and poles has been rather large.

These difficulties have had an important influence in causing us to reach a decision in favor of the third rail. The contact shoes, which take the current from the rail to the motor circuit, have given, on the whole, good satisfaction, although they are occasionally carried away by the approach blocks at grade crossings when these blocks happen to be slightly misplaced so that the shoes strike them at the wrong angle. The contact shoes are suspended by cast iron links, which are intended to be weak enough to allow the shoe to break away easily without doing damage to the frame work of the car. The trail cars are also equipped with shoes, and connected with the circuits on the motor car by means of flexible couplings, and it is possible therefore, when the cars are run in train, to bridge the longest gaps found at grade crossings and switches, so that it is not necessary to turn the current off on approaching these. This arrangement makes our trail cars independent of the motor car for heating and lighting.

It will be noted that the Nantasket cars have two trolley poles, as well as contact shoes, and the change from trolley to third rail simply means the pulling down of the pole and the closing of the third rail switch.

Our third rail and return circuit experience will, perhaps, be of value to both street railway and railroad managers, as we have undoubtedly made a wide departure from established methods.

First is the question of insulation. The third rail has a potential of 600 volts above the ground and rests upon creosoted wooden blocks doweled into the ties, its eaves being only $1\frac{5}{8}$ inches above the tie. Now it frequently happens that water accumulates 2 inches or more in depth over the ties, and, if it were not for our experience to the contrary, we would naturally suppose that, under these circumstances, the line would be directly short-circuited between the third and service rails through the water, the distance being but about 2 feet each way. Nevertheless, we have been able to operate our road without the slightest difficulty when this has happened, and nothing unusual has been noticed at the station, nor has the electrical output, as registered by the recording wattmeter, been abnormal. At Berlin we have watched the ammeter closely when we knew the tracks to be submerged in two places 10 miles apart, during a heavy rainstorm, and have found that the leakage was almost imperceptible when both cars on the line were at rest and their air pumps out of circuit. At that time the wattmeter was standing still. Of course, if a long length of track were submerged, the leakage might become serious, but we have yet to learn how much is necessary to accomplish this result.

We aim to so connect our third rail lines and the service rail return as to have a practically complete metallic circuit of extremely low resistance; as far as possible insulated from the ground. We do not believe in grounding our track, and, though ground plates are placed at the station, connected to our generator, by far the largest proportion of the return current comes through the cables connected directly with the track, the percentage coming from the ground plates being extremely small.

The joints of the third rail are bonded by long copper plates, firmly bolted to both sides of the joint, sixteen bolts being used in all. These copper plates are tinned before being put into position. Owing to the large area of contact surface, the presence of rust on this surface does not materially interfere with the conductivity of the joint, as shown by accurate tests.

The service rails are bonded with the greatest care, four copper leaf bonds, having a cross section of copper equal in conductivity to that of the rail, being used. These bonds are inserted in the base of the rail instead of the web, so as to prevent breakage through play at the joints. The copper leaves are cast into end piece blocks in such a way as to weld them thoroughly together in the blocks. The latter are formed into a hollow cylinder, 1 inch in diameter, which passes through a hole in the flange, and by which a large area of contact is secured. Taper pins are driven into the inside of this cylinder from the top of the flange, and the connection made is very perfect. Careful tests have shown that the joints of both third and service rails have now a slightly greater conductivity than an equal length of the rails themselves.

A few words about the danger of the third rail system would be perhaps in order. There have been many cases of people who have stepped from the ground to the third rail without feeling the current, and anyone can step upon it from a dry tie without the slightest effect. On all except wet days our employes work about it without trouble, avoiding, of course, putting themselves in direct contact with both service and third rails, but not infrequently "monkeying" with the current in such a way as to get shocks of more or less severity in a sort of horseplay. On wet days they refer to the third rail as being "lively," and are inclined to let it alone. Many of our employes have, however, received the heaviest shock possible to obtain, time after time, and care little about it, though those who are more influenced by electric shocks than others are sometimes thrown off their feet, but recover fully in a few minutes. We do not say that the third rail has no dangers, but we do not consider the danger as being at all serious or one which should interfere with the extension of the system.

As a result of exceptional care which we have taken in bonding our third and service rails we have found it unnecessary, in any third rail work so far done, to use copper feeders, in spite of the fact that we are obliged to transmit current from Berlin to Hartford, a distance, as before stated, of 12·3 miles straight away from the power station. This work is made up as follows: From Berlin to New Britain, a distance of 3 miles, there is a complete double track electric road, with two 93-pound third rails and four 74-pound service rails, all most carefully bonded as described above; from New Britain to Hartford, a distance of 9·3 miles,

* Abstract of paper read at the convention of the American Street Railway Association, Niagara Falls, 1897.

there is one complete electric track, with 100-pound third rail and 70-pound service rails, all carefully bonded, in addition to which we have connected to the service rails of the electric track the rails of the second track, paralleling this the entire distance, at various places, in order to get the benefit of whatever conducting power there might be in this track connected only by its fishplates at the joints. As a result of this work, we are able to run two trains of 52 tons each on the New Britain and Hartford line, with an average loss of but 20½ per cent. The current output of the station at such a time averages about 300 amperes, with a maximum flow of about 700 amperes at a pressure of 600 volts. Of course, if the service were heavier, so that more cars would be required, it would undoubtedly be necessary to reinforce the third rail with feeders.

In spite of the fact that the general conditions of operation do not point to a low cost of power, because of the fact that we are working neither station at anywhere near its full capacity, I suppose we are, as a matter of fact, producing power more cheaply than can be done in any power station in the country using coal as a fuel, the reason being that we are burning sparks. "Sparks," as we are accustomed to call them, are the half-consumed coal dumped from the extension front of locomotives at the company's various round houses. Nevertheless, there is a great deal of steam generating value in these sparks, as we have found by experience, and they are being carried on the company's cars to our stations at Berlin, Nantasket and Stamford, and charged to the electrical operation at the cost of freighting (including the usual profit to the company for transportation), plus the cost of loading and unloading, a total charge of 70 cents per ton delivered.

In order to burn these sparks we are obliged, of course, to make some changes in the furnace arrangements, chief among which is provision for the introduction of live steam under the grates, forming a blower or forced draught as well as providing the water which, in decomposition, furnishes the oxygen and hydrogen gases, which increase greatly and facilitate in combustion of half burned coal and add enormously to the furnace heat. We originally supposed that some form of shaking or self-cleaning grate would be necessary in burning sparks, but have found in practice that, with ordinary grates together with the steam blower, there is no difficulty. In our experimental days, it was thought that it might be necessary to use a proportion of ordinary soft coal with the sparks, and we did so for a while, but it was not long before our firemen were educated to burn sparks only with entire ease, and no other kind of fuel is now used by us. Of course we have to use a greater weight of this half consumed coal than would be the case with new coal, but still the economy is great, as a good quality of run-of-mine coal costs us in Connecticut about $3 per ton delivered at power station.

As before stated, our Berlin plant has not been run as economically thus far as it will be when a greater load is put on the engines, and it will seem to be in the interest of economy to run compound condensing. At this station the cost of fuel, with the use of coal, has been 9 mills per horse power hour, or 12 mills per kilowatt hour. Using sparks as fuel has reduced this cost to 3 mills per horse power hour, or 4 mills per kilowatt hour.

It is very difficult, of course, if not impossible, to make any direct comparisons between the cost of motive power for electric railroading and that for steam railroading, on account of the different way in which the trains are made up. The best criterion would be the cost of motive power per ton mile hauled, but even here the results would be of little value on account of the wide difference in conditions, and, as a matter of fact, we have never attempted to make such comparisons.

I have tried to give you, as briefly as possible, some of the results of the pioneer work which the New Haven Company has been doing in heavy electric railroading. They are roughly stated, and we cannot pretend that they are in any way conclusive as affecting general railroad practice. For ourselves, however, we have formed some definite ideas as to what is possible for us to accomplish, and our plans for the future are being made with great care by President Clark and the Board of Directors, with the intention of dealing with the new transportation conditions which confront us in a broad minded and progressive way. It is felt that a great transportation agency of this character owes it to the public from which it has obtained its franchises to furnish the best possible service and to make the most of the natural advantages which it possesses.

There will always be room, doubtless, for railroads of two characters, the one operating on a purchased right of way, where trespassers can be kept away and high speed obtained, and the other operating on streets and highways, where passengers can be taken up and let off at their own doors. It is possible that, in some thickly settled districts, such as are found in New England and the Middle States, where population groups almost touch each other, these two classes of service may occasionally be performed by the same agency, but there is no reason, ordinarily, why there should not be the most amicable and friendly relations, and not infrequently of a business character, existing between steam railroad and street railway companies.

Bicycle Rim Cement.—A good thick shellac varnish with which a small amount of castor oil has been mixed will be found a very excellent bicycle rim cement. The formula recommended by Edel is as follows:

Shellac	1	pound.
Alcohol	1	pint.

Mix and dissolve, then add

Castor oil	½	ounce.

The castor oil prevents the cement from becoming hard and brittle.

A cement used to fasten bicycle tires may be made by melting together at a gentle heat equal parts of gutta percha and asphalt. Apply hot. Sometimes a small quantity each of sulphur and red lead are added (about 1 part of each to 20 parts of cement).—Pharmaceutical Era.

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M. BAZIN'S ROLLER STEAMSHIP.

No invention involving so radical a change in the construction of steamships has been put before the public since the first steamers were produced at the beginning of the century as the "roller" steamship of M. Bazin, the French engineer. Hitherto, the hull of a ship has been built more or less egg shaped, but the Ernest Bazin consists of a flat rectangular deck supported upon twelve disks or wheels. The vessel, which was launched last year, is only an experiment, so to speak, and is therefore small, being only of 274 tons burden. M. Bazin hopes in time to build a steamer large enough to cross the Atlantic. Meanwhile, he has been trying the experimental steamer. The Ernest Bazin has six floats or wheels; her length is 131 meters, and breadth 39 meters. On the deck are the cabins, saloons, machinery and boilers. The whole idea pursued in the construction of the vessel has been the reduction of friction with a consequent increase of speed at a minimum of expense and effort, by rolling through the water instead of cutting through it. Each of the rollers has a displacement of about 45 or 46 tons. The rollers serve, it will be seen, not only as part of the means of propulsion, but also take the place of the hull in an ordinary vessel. The Transatlantic liner which M. Bazin proposes to build is to have four of these wheels instead of three as in the experimental steamer. The shafts for making the wheels revolve pass below and across the platform, and, like the wheels, are of steel. M. Bazin argues that in order to obtain a maximum rate of speed there must be a corresponding relation between the rotary force and the propelling force, and his steamer is fitted with two independent sets of engines, one to drive the rollers and the other to propel the vessel forward by means of a screw. Among other advantages claimed for the vessel may be mentioned the small amount of rolling and the ease with which repairs to the hull can be attended to, docking being unnecessary. Then again it is urged that if a wheel is damaged the injury can be made good without stopping the vessel, for the injured wheel and its corresponding wheel on the other side can be stopped while repairs are done, while the others can continue their course through the water. On July 29 the Ernest Bazin went on a trial trip from Havre. On board her was Sir Edward J. Reed, who went to ascertain from personal observation how the vessel behaved, and more especially in what degree the speed would be affected by applying part of the available steam power to the rotation of the rollers instead of to the direct propulsion of the vessel.

Sir Edward Reed's report to the Société d'Etudes et d'Exploitation des Navires Rouleurs Bazin has just been issued. The vessel's engines are of 350 I.H.P., and these engines work both the screw machinery and the rollers jointly; so that in this vessel of 274 tons displacement there was only about one-seventeenth of the steam power requisite to drive a vessel of similar size at thirty knots, and one twelfth of that necessary to drive her twenty-seven knots. Nothing but a very low speed could, therefore, be anticipated of the vessel, owing first to her smallness, and secondly to her low steam power. A small vessel is, in Sir Edward Reed's opinion, very unsuited to the application of the Bazin system. The rollers are of necessity too close to each other, and consequently the systems of waves which the onward movement of the rollers creates and sends off on each side of each roller very soon reach each other and cause reactionary turmoil, which is unfavorable to smooth and easy progress, whereas in a much larger ship the progress would be much less interfered with by this cause. Then, too, so small a vessel is necessarily shallow, and no proper immersion can, under ordinary conditions, be given to the screw propeller, and a screw propeller works at a very great disadvantage when too near the surface. However, in spite of the disadvantages under which the system was tried, the vessel surprised Sir Edward Reed by its performance, and he gives the following results of the experiments made on the trip:

"We began the trials off Havre with very small power and speed. In the first two measured runs only about 112 I. H. P. was exerted by the screw propeller engines, giving, with the rollers at rest, a speed of 4·25 knots. Keeping only the same propelling power at work, but causing the rollers to revolve seven turns a minute by the application of 25·08 I. H. P., we obtained a very remarkable increase of speed, which rose to over 6 knots (more exactly 6·39 knots). I have calculated what the increase of speed would have been had this 25·08 I. H. P. been added to the screw engines instead of being applied to the rollers, and I find that by this means we should merely have added 0·55 of a knot, thus raising the speed from 4·25 to 4·8 knots only.

"In the next experiment the power exerted upon the screw was increased to 295 I. H. P. and the roller power to 34·2 I. H. P., the rollers revolving nine turns per minute. I calculate that with the rollers at rest, the increase of horse power upon the screw should have raised the speed from 4·25 to 5·8 knots. The actual speed attained was 6·81 knots, giving an excess of speed due to the revolution of the rollers of 1 knot. It will be seen that this gain is not quite so much as in the previous case, although the power applied to the rollers was somewhat increased—a fact that may be conjecturally accounted for in several ways; but there remains the remarkable fact that the vessel steaming at say 5·8 knots only, with 295 I. H. P. applied to her screw, is increased in speed by fully a knot by the application of only one-ninth of that power to her rollers! A further, but small, increase of speed (from 6·81 to 6·97 knots) was obtained by increasing the power on the rollers to 52·2 I. H. P. Small as this increase was, it nevertheless points to the fact that the additional 18 I. H. P. was much more efficient when applied to the rollers than it would have been if applied to the screw propeller."

THE ROLLER STEAMER ERNEST BAZIN LEAVING HAVRE ON A TRIAL TRIP.

In conclusion, Sir Edward Reed says:

". . . There can be no doubt whatever that the experiments conclusively demonstrated that the Bazin rollers furnish an effectual means of greatly reducing the friction which a floating body encounters in its advance through the sea, and friction is certainly one of the most serious of the elements which compose the resistances encountered. It does not, of course, remove or evade all friction, for all the ascending and descending parts must of course encounter some friction even in still water; as must also those immersed parts of the roller which are not retreating, so to speak, or moving sternward, with precisely the same velocity as the ship advances; but, as regards these latter, it must be remembered that all are moving sternward at some velocity, and therefore all are avoiding, to some extent, the resistance due to friction. It has been conclusively shown, I think, that on this question of reduced friction and consequent increase of speed or decrease of power, M. Bazin's views have been in a general sense fully established."

The reports of a number of pilots who have had charge of the vessel on various occasions go to show that she behaves well in a fresh breeze and rough sea, and that she is an exceptionally dry boat and easily handled. We are indebted to the London Graphic for the engravings and particulars.

PNEUMATIC LOCKS FOR CANALS.*

By CHAUNCEY N. DUTTON, New York.

THE first canal lock was built about 1490 by Leonardo da Vinci to relieve the commerce of Milan. He had not cheap steel, therefore could not use materials in tension. A good mechanic and engineer, understanding perfectly the qualities of masonry and timber, the ancient materials of construction, he used them so skillfully that his work could not be improved until modern progress gave us steam power and cheap steel and made possible structures depending on tensile strength. Engineers have attempted substitutes for Leonardo's lock, but with very moderate success. Edwin Clark, of England, built balanced hydraulic lifts, suitable for small single boats, where the foundation could be rock, and the German government has recently built a lock operated by four huge screws at the corners, assisted by a float. But locks of these types are inherently defective and involve the risk of dislocating the transportation system and the exchange of commodities, which in our modern civilization would cause business paralysis, ruin and starvation.

These attempted structures have required delicate manipulation, exact regulation of the canal levels, and

Third: Absolute immunity from falling. The pneumatic lock falls up, if it falls at all. It is pressed up firmly against the anchors with an effort much greater than the weight of the lock and its load. If the anchors yield, the lock is forced up to a height such that the air in the air chamber is expanded to equilibrium with the load, and a volume of water equal in weight to the difference between the load and its initial excess of buoyancy has entered the air chamber.

Fourth: Water trap valve for controlling the air conduit.

Fifth: The powerful automatic leveling or synchronizing shafts, of construction cheap, and such that the price per pound does not increase with increased power.

Sixth: Dispensing with the dry dock and operating the lock directly in the lower level of the canal in a pit, the pit in which the lock works being part of the lower level.

Seventh: The substitution of steel, mainly in tension, for masonry. A thin steel plate will do more work than the heavy masonry walls of the Leonardo locks. In most situations the pneumatic lock requires masonry only to support the guides and as weights for the anchorages.

Eighth: Substitution of elastic resistance for mere stability due to dead weight, which reduces the strains due to shocks so that they can be taken care of economically.

The principal elements are:

1. The locks, which are identical structures, in balance, each having a lower open-bottomed air chamber on which it floats and an upper gated lock chamber,

There is an interlocking apparatus or sequence machine which prevents doing the wrong thing at the right time while working the locks and a governor which keeps the locks from running away and stops them at the right elevation.

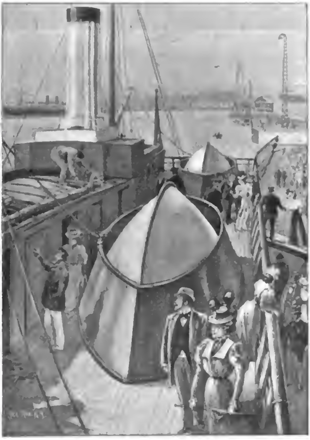
It is obviously impossible to exactly balance any load, especially a variable load, upon an unstable medium, such as air. It was, therefore, necessary to do one of two things; either

a, to make the lock deficient in buoyancy and provide a rigid auxiliary support, or

b, to make the lock superbuoyant and restrain it from rising too high by the engagement of the lock structure with anchors.

The latter was adopted after many designs of the first type had been considered and found defective. The elevated lock is firmly held and thrust upward against the anchors, which restrain it, with a surplus buoyancy or lift exceeding any possible variation in load or buoyancy. The air pressure in the elevated lock is great enough to expel from the air chamber a weight of water 25 to 30 per cent. greater than the weight of the loaded lock, the upward strain being held by anchors before referred to. This constant working pressure is maintained by a pneumatic accumulator, which is a cylindrical tank, movable vertically and weighted to give the desired working pressure, and which is connected with the elevated lock and has sufficient volume to provide for such leaks as may occur and for changes in the density and temperature of the adjacent atmosphere. The depressed lock floats as a pontoon and requires no care.

The machinery connected with the locks, besides the



VIEW OF THE DECK.

VIEW OF THE BOWS.

ON WHEELS ACROSS THE SEA—THE NEW ROLLER STEAMBOAT ERNEST BAZIN.

required the maintenance of dry docks in the lower level big enough to contain the locks and their appurtenances, which land therein when they descend.

A lock is the heaviest of engineering structures, carries per square foot a load greater than the load per running foot of the heaviest railroad bridge, and is subject to tremendous and cumulative distorting forces. Therefore, a lock structure must be of simple type and extreme power, and automatically guided and controlled by apparatus strong enough to, beyond peradventure, arrest distorting forces in their incipiency.

Locks and aqueducts are liable to be rammed by boats. In old fashioned structures either the structure or the vessel must be wrecked. A steel structure properly designed can cushion a blow so that it will be harmless.

The work done in perfecting the pneumatic lock may be briefly described as follows:

First: The substitution of compressed air for water as the support of the locks and vessels. Increasing the height of the air column does not increase the pressure, and therefore high lifts are operated with the same pressure which operates low lifts.

Second: The use of low pressures in lieu of high pressures, the air pressure being very little greater than that due to a column of water in height equal to the draught of the locks. The working pressure in the lock with 12 feet draught is 8 pounds per square inch; with 30 feet draught, 16 pounds.

containing the water for floating the boats, and working in a pit formed in the lower level.

2. A valve-controlled air conduit system, for transferring air from one lock to the other.

3. Anchorages to restrain the superbuoyant elevated lock, these being built integral with—

4. Guiding structures to prevent the locks from tilting sidewise.

5. Automatic parallel motion, or synchronizing apparatus, to keep them from pitching endwise.

The locking members are built of steel, and each like a long gas tank, with a gated lock built on top of it.

The gates move about a center, like a locomotive throttle valve, and when open lie back in pockets at the side of the lock, and have buffers or cushions which elastically cushion the blows of the boat.

The air conduits extend from the air chamber of one lock to that of its mate, and have a U bend which makes a valve like a sewer trap. When the trap is full of water the air conduit is closed, and when the water is drained out of the trap air can pass from one lock to the other. There are side guides to keep the locks from tipping over sidewise and automatic levelers to keep them from pitching endwise. This automatic leveling apparatus consists in racks built on the moving lock, fixed racks built parallel thereto on the piers, and shafts along the sides of the locks and carrying pinions which mesh with the racks on the locks and the parallel fixed racks. As the locks move, the shafts and pinions roll between the fixed racks and the lock racks with which they mesh.

interlocker and governor, are hydraulic stops or cushions, which stop the lock gradually to prevent shock, a hydraulic accumulator and pump, an air compressor to supply leakage and to transmit power to the gate-opening engines, the capstans which pull the boats in and out, and to the interlocking machine and valves.

The operation of the locks is as follows: The moving power is a surcharge of water in the elevated lock, containing, say, a foot greater draught than the depressed lock. If the boats enter or if they be left out it makes no difference in the weight, and when the gates are closed the locks are ready to be translated. If then the water be drained out of the big trap valve, the excess of weight in the elevated lock will cause the air to flow into the lighter depressed lock, which will ascend, and the heavier elevated lock will descend; the machine being controlled by the side guides which keep the locks from tipping sidewise, and by the synchronizing shafts and gearing, which keep them from pitching endwise and maintain them perfectly level and true; the motion being practically frictionless or attended only by rolling friction. As the surcharged lock approaches the lower level it automatically takes on an additional load of water, inducing a great increase in the compressed air charge, which increase, transmitted through the open conduit to the elevated lock, thrusts it firmly up against its anchors with a buoyancy, say, one-fourth to one-third greater than the weight of the lock and its load. The main air conduit trap valve is then shut by filling it with water, and the air chamber of the elevated lock is connected with the loaded air tank or pneu-

* Abstract of lecture before the Franklin Institute, November 12, 1897.

matic accumulator, which automatically compensates for variations in the temperature or density of the adjacent atmosphere and also supplies such small leakage as is unavoidable. The gates of the depressed lock are then opened, and its buoyancy is increased so that it will float with just the desired depth of water with which it should rise.

The joint is then made between the elevated lock and the aqueduct face, and the space between the adjacent gates in lock and aqueduct is filled with water and the gates opened. The boat which has been raised is then swelled out into the aqueduct, or upper level, and the boat which is to descend is swelled into the lock, which at the same time is lowered and takes on the surcharge or greater draught of water which is the moving power of the system.

The distorting or destructive forces which are provided against are:

1. Shocks and blows due to bumping or ramming by the boats.

2. Sinking of the boats in one end or one side of the locks, producing uneven loading and tendency of the boat to tilt sidewise and pitch endwise.

3. Wind pressure.

4. Variations in the density and temperature of the adjacent atmosphere.

Provision is also made for raising the locks out of the water, so that they can be painted and repaired.

This invention substitutes steel for masonry and timber in lock structures, and renders feasible the building of canals with long levels and very high lift locks, few in number, and causing a little detention. Therefore it renders canals practicable in dry countries and over mountain ranges.

These locks give the engineer great freedom in planning his canal levels, and do away with the waste of water, as the canal bottom can be put down low enough to provide draught at the lowest water, and the banks carried high enough to hold the highest water.

BRIGG'S BICYCLE ATTACHMENT.

In the accompanying illustration is shown attached to a safety bicycle a secondary handle bar, with merits and demerits which are obvious. The ideas which the inventor, Mr. Brigg, of Harley Street, London, W., has set himself to carry out are based upon perfectly sound physical and mechanical principles, as regards rest for

the back of the rider and increased purchase for hill climbing and back pedaling. As will be seen, the inventor fixes to the top bar of the frame of the bicycle a secondary handle bar, which is vertically rigid, but is connected to the ordinary handle bar by a spring for steering. This auxiliary bar is provided as a means of rest for the muscles of the back when riding easily on the level, but for hill climbing greater effort can be exerted on the pedals by using it as a fulcrum, in which case the rider, holding the front bar in the usual way and pressing up against the auxiliary bar with the arms, is enabled to put additional pressure upon the pedals. Such are the advantages derivable from this duplicate attachment, but whether they compensate for the increase of weight or are sufficient to alter a fashion in the shape of bicycles now fairly matured it is not our intention to comment.—The Engineer.

THE DE LAVAL STEAM BOILER.

A few years ago, in presenting the de Laval steam turbine to the Society of Civil Engineers of France, we concluded with the following words: "The de Laval turbine cannot at present, with the ordinary pressures of steam, consume more than 7·3 kg. of the latter per effective h. p. and per hour.

"With higher pressures, a still greater reduction in the consumption will be obtained, and this is the great future of these machines.

"We are far from the limit that generators will be able to reach. They operated at the outset at a pressure of 2 kg. and even at the pressure of the atmosphere. A pressure of 4 kg. was considered as dangerous. But pressures of 6, 10 and 15 kg. have been progressively reached, and there is no reason why one of 30 kg. or more may not some day be attained.

"Now, piston motors are incapable of running at such pressures, while the de Laval turbine will be able to utilize steam perfectly at any pressure whatever, since the latter is converted into live force before entering the motor itself.

"A more precise examination of the question gives an idea of the great saving that may be obtained from high pressures with the de Laval turbine."

Our previsions of that time are now realized and even exceeded. What was our desideratum at that moment is now a reality.

The same ingenious inventor who devised the first steam turbine has just brought out a boiler capable of furnishing steam at 220 atmospheres.

What particularly characterizes M. de Laval's boiler, aside from its high pressure, is its automatic operation and regulation. In fact, the feeding with coal, water and air and the regulating of the steam production are done by the apparatus itself.

The steam generator, properly so called, consists of a continuous tube, through one extremity of which the water is injected, while the steam escapes from the other.

The vaporizing tube is of cylindrical section and of from 25 to 30 mm. internal diameter, and forms a series of concentric spirals around a conduit through which

creasing strength, it closes in succession the apertures that allow the steam to pass to the ajutages.

The following operations take place automatically: The coal descends upon the grate and is carried along by its rotary motion; the apparatus, K, under the action of the steam, causes the operation of the registers, a_4, a_8 and a_6, which allow of the passage of the air introduced by the blower driven by the turbine; and the feed pump, G, is actuated by the turbine, as is also a centrifugal pump coupled directly with one of the driving shafts and supplying the condenser, B.

As soon as the machine is charged, its regulator

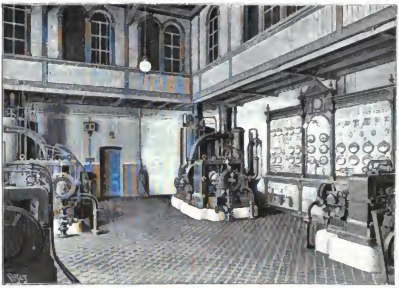


FIG. 1.—A DE LAVAL BOILER AND TURBINE AND A DYNAMO IN THE ENGINE ROOM OF THE JERLA WORKS, NEAR STOCKHOLM.

the coal is introduced. The whole is comprised in the annular space of an iron plate cylinder lined with heat-proof materials.

Below the conduit under consideration there is an arrangement which facilitates the continuous renewal of the coal and the cleaning of the grate. In the interior of a revolving grate, in the form of a truncated cone, there moves with a different velocity a cone of refractory bricks that carries along the fuel. Between the grate and the coal there is a loop in the water tube that performs the part of a scraper and keeps the grate constantly clean.

The boiler is provided with apparatus for regulating the supply of water and the admission of air into the furnace. The operation of these apparatus is based upon the action of balanced pistons by the pressure of the steam on one side and of the water under pressure and of springs on the other.

Fig. 2 gives a diagram of a complete installation of the boiler, turbine, condenser and accessory apparatus. The coal, which is introduced at the top, falls upon the cone, a_7, and fills the conduit, a_6, which is afterward closed. The reservoir, b_4, as well as a portion of the spiral, is filled with water.

As soon as the fire is lighted, the steam begins to be disengaged at a_4, and, through the regulators, D, and

opens the apparatus, E, slightly, the water loses some of its pressure, and the pistons of the apparatus, D, move in the contrary direction in allowing of the passage of a quantity of steam sufficient for the work required from the turbine.

The steam under a pressure capable of reaching 220 atmospheres (corresponding to 375° C.) enters the ajutages and completely expands therein up to the pressure of the condenser before being projected against the paddles of the turbine. After effecting its work, it goes to the surface condenser, B, whence, after condensation, it is forced by the pump, F, into the reservoir, b_4, and is thence taken up by the feed pump, G, and forced into the steam generating tube.

The centrifugal pump keyed upon one of the auxiliary shafts of the turbine furnishes water under pressure to a sort of ejector, b_5, which communicates with the space, b_1, where the steam condenses and thus carries along the air that may chance to exist therein. After passing through the ejector, this water is directed into the condenser upwardly, and thence flows to the exterior. The centrifugal pump thus performs the office of both a circulating and air pump.

The apparatus, H, branched upon the conduit of the feed pump, in which there prevails a pressure higher than that of the steam in the generator, constantly

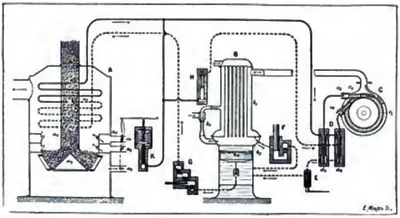


FIG. 2.—DIAGRAM OF A DE LAVAL BOILER.

A, the boiler; B, the condenser; C, the turbine; D, the steam regulator; E, the water pressure regulator; F, pump of the condenser; G, feed pump; H, apparatus for balancing the pressure of the steam and of the water circulating in the regulator, D

the ajutages, e_1, e_2, e_3 and e_4, enters the turbine, C, which revolves with greater and greater velocity in measure as the pressure increases.

The apparatus, E, which was completely open, and in which the water coming from the feed pump, G, through the intermedium of the apparatus, H, circulated freely, begins to close through the action of the regulator and turbine. The pressure of this water, thus intercepted, progressively increases in the apparatus, D. In adding itself to the action of the springs, which are of unequal and progressively de-

balances the pressure of the water that circulates in the regulator, D, with the pressure of such steam and thus prevents the regulator from being always closed to the passage of the latter.

The blower, which is keyed upon one of the auxiliary shafts of the turbine, furnishes the quantity of air necessary for the combustion and produces the draught. The regulator, K, regulates both the action and the discharge of the steam, now opening and now closing the registers, a_4 and a_5, according to the pressure of the steam and the charge of the machine.

Lastly, it is capable, while closing the registers, a₃ and a₄, of opening the register, a₁, and of thus blowing fresh air upon the spirals themselves so as to arrest the production of steam.

The boiler is capable of vaporizing from 35 to 40 liters of water per square meter of vaporizing surface and of furnishing from 7·5 to 8 kg. of steam at from 100 to 220 atmospheres per kilogramme of coal.

Among the principal advantages of the new boiler may be mentioned its simplicity, its lightness, the little space that it requires, the ease with which it may be installed and operated, the rapidity with which it is set in operation, its production of dry and superheated steam, etc.

The electric lighting of the Universal Exposition at Stockholm this year is assured by the de Laval turbines and high pressure boilers. The electric plant comprises four groups of 100 h. p. and two of 50 h. p. Each group is composed of one turbine, one dynamo turbine and one condenser, as well as the accessory apparatus for feeding and regulating actuated by the turbine.

The steam turbine manufactory at Jerla, near Stock-

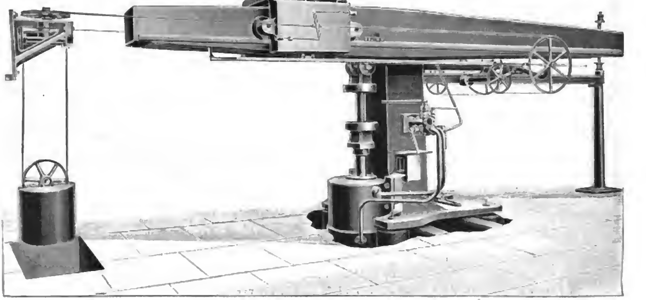
Grate area....	2·51 sq. m.	(27 sq. ft.)
Wheel base, fixed maximum	2,600 mm.	(8 ft. 9·5 in.)
" " total..........	6,460 mm.	(21 ft. 2 in.)
Feed water, in tanks.	4 cubic meters	(880 gal.)
" " in boiler.......	3·8 "	(836 ")
" " total capacity,	7·8 "	(1,716 ")
Fuel	1·5 "	(53 cub. ft.)
Weight, empty...	55 tons.	
" in running order..	69·9 "	
Axle load, maximum	14 "	
Gage.....	1,435 mm.	(56·5 in.)

The engines have especially been constructed for pulling heavy trains on the steep gradient of 1:50 and 1:30 of some Thuringian mountain lines of the Prussian state railways, Probstzella-Wallendorf, Schwarzathal, Triptis-Blankenstein and Ploen-Ritschenhausen. The special conditions refer to gradients of 7·5 kilometers (4½ miles) lengths and various minimum curves. On gradients of 1:30 and curves of 180 meters (590 ft.) trains of 250 tons were to ascend at a speed of 15 kilometers (9·3 miles), 110 tons were to ascend at a speed of 30 kilometers (18·6 miles); on gradients of 1:40 and curves of

object aimed at has fully been attained, for on gradients of 1:40 with curves of 200 meters (656 ft.) radius, trains of 296 tons have been pulled with a speed of from 17 to 20 kilometers (10·6 to 12·4 miles), and trains of 330 tons with a speed of 13 kilometers (8 miles); and on gradients 12·5 kilometers (7¾ miles) in length, of 1:50 with curves of 320 meters (1,050 ft.) radius, the required speed of 15 kilometers (9·3 miles) has been maintained with trains of 300 tons. The specified conditions have hence been more than fulfilled. The engines are said to move very smoothly, owing chiefly to the particular construction of the framing, which is not rigid, but linked, enabling the locomotive to take all curves easily and to adapt itself to irregularities in the track, without impairing the adhesion.—Engineering.

ONE HUNDRED TON TESTING MACHINE.

THE fine machine illustrated herewith was made by Messrs. J. Buckton & Company, of Leeds, for the Dowlais-Cardiff Works, where it is now in use. It is constructed under the Buckton and Wicksteed's patent, and is actuated throughout by hydraulic pressure



ONE HUNDRED TON TESTING MACHINE.

holm, is likewise run exclusively by these new boilers. In Fig. 1 is given an internal view of this station. To the right of the engraving may be seen a group of apparatus consisting of a boiler, a dynamo turbine, a condenser and various accessories.—K. Sosnowski, in La Nature.

THE HAGANS COUPLED LOCOMOTIVE.

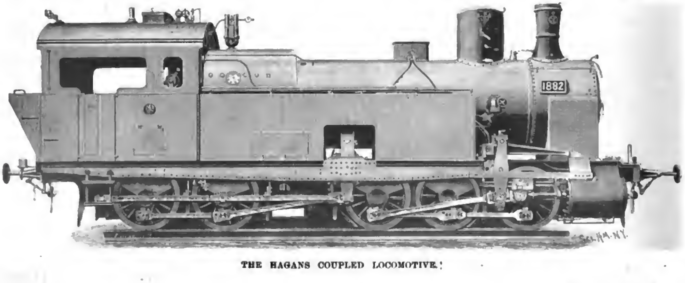
WE illustrate herewith a locomotive built by the locomotive works of Henschel and Sohn, Cassel. The Prussian State Railway Department had originally ordered two of these engines; several more have already been added. Of the five coupled axles of these locomotives three have their bearings in the main frame, the other two in the bogie frame; the coupling is as described on the occasion referred to. The chief dimensions of this locomotive, which can pass over normal (1,435 millimeters) gage lines with curves of 180 meters (590 feet) radius, are:

Cylinders, in diameter	520 mm.	(20·48 in.)
" stroke	630 "	(24·8 ")
Wheels, diameter	1,200 "	(47·2 ")
Steam pressure.......	12 atmos.	(175 lb.)
Heating surface, direct	8·16 sq. m.	(87·84 sq. ft.)
" " indirect..	129·05 sq. m.	(1,389 sq. ft.)
" " total......	137·21 sq. m.	(1,476·8 sq. ft.)

200 meters (656 ft.) the speeds were to be 15 kilometers (9·3 miles) for 270 tons and 30 kilometers (18·6 miles) for 100 tons; on gradients of 1:50 of 7¾ miles length and curves of 350 meters (1,148 ft.), speed of 15 kilometers (9·3 miles) was to be maintained for trains of 330 tons. For the calculations, coefficients of 0·18 (start) and 0·15 (run) were to be adopted for the friction between wheels and rails. The capacity for coal, 6 cubic meters (212 cubic feet) and for water, 7 cubic meters (1 544 gallons), were to suffice for runs of 20 kilometers (12·5 miles).

The load on each axle was not to exceed 17 tons, grate area and heating surface could not be dimensioned as in ordinary usage, but the designers have availed themselves of an expedient to which engine drivers resort in cases of forced runs, that is, to keep plenty of water in the boiler. The boiler has a diameter of 1,600 millimeters (63 in.), is raised a little above the firebox, and the firebox is made so low that it does not project more than 76 millimeters (3 in.) above the middle of the boiler. By these means the water level can be varied by 400 millimeters (16 in.); the boiler is, therefore, for all purposes, very spacious, and can carry 3·8 cubic meters (836 gallons) above lowest water level. The remaining 4 cubic meters of water are kept in a lateral tank; in these 3·8 cubic meters of heated water are stored up so that the engine can rapidly get up plenty of steam when arrived at the foot of a steep gradient. The

brought from the works' accumulator. The straining piston will put on a pull up to 100 tons at any desired speed, the speed being regulated by a hand lever on the hydraulic valve. Another valve admits the hydraulic pressure to a horizontal ram which actuates the traveling poise weight, which can be advanced along the steelyard at any desired speed by regulating the hydraulic valve. The result of this arrangement is that strong samples of plates up to 3 in. area in cross section can be tested with perfect accuracy as to their ultimate strength and total extension at the rate of sixty pieces per hour, and a record has been reached with lighter pieces of 120 in the hour. The gear which transmits the power from the horizontal hydraulic ram to the poise weight is so connected to the poise as to apply the force strictly in a horizontal direction, and to be incapable of supporting any part of the poise weight, or influencing in any way the sensibility in the oscillations of the steelyard. The machine is extremely massive, and the principle which enables such rapid testing to be delicately conducted is that of employing a very heavy poise weight with a very low velocity of oscillation. The steelyard is of the double armed type, invented by Mr. Wicksteed. The poise weight when at zero is at the end of the negative arm. In this position it is balancing an equal weight on the long arm or positive end of the steelyard, the result being that with

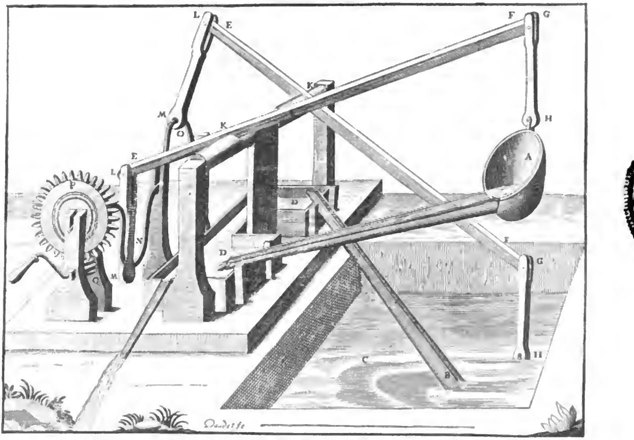


THE HAGANS COUPLED LOCOMOTIVE.

a 30 ... poise a total weight of three tons is utiliz... in measuring the strength of the sample, and the velocity ratio between the end of the steelyard and the testing shackle is only 33 to 1. The accuracy of the machine is guaranteed to 1 in 5,000, and although the steelyard and poise weigh together about four tons, yet they offer such small inertia resistance that the strength of sewing cotton can be measured on this machine with as much accuracy as with dust shot in a scale pan. The arrangements for returning the poise weight and the straining piston will be readily understood from the illustration. We are indebted to The Engineer for the engraving and article.

MACHINE FOR DRYING UP A MARSH OR FOR DRAWING WATER FROM A SHALLOW PLACE.

THE large bowls, A, B, which are to draw water from the reservoir, C, and raise it to the reservoir, D, are attached, through the extremity of their gutter, to iron pins moving upon the edge of the reservoir, D. They are suspended by the levers, E, F, at their end, F, through a forked link, G, H, and these levers, whose center of motion is at K, are drawn at their extremity, E, by two other links, L, M. These two last links being attached through an eye to the two cranks, N, O, of the wheel, P, raise and lower the levers, E, F, and consequently the bowls, A, B, when the wheel, P, revolves.



MACHINE FOR DRYING UP A MARSH OR FOR DRAWING WATER FROM A SHALLOW PLACE.

This latter is actuated by hand through a winch that one places at the end of the axle of lantern wheel, Q.—From Recueil d'Ouvrages Curieux de Mathematique et de Mécanique, 1733.

LOCOMOTIVES FOR JUNGFRAU RAILWAY.

THE Jungfraubergbahnelectromotive is said to be the most powerful cogwheel locomotive which has ever been constructed, and it will be granted that it has the advantage, if that is anything, of a very long name. It is being built by Messrs. Brown & Boveri, of Baden, for working the trains on the gradients of the Jungfrau; and as it is of peculiar design, unlike anything of the kind on any other mountain railway, we give a few particulars which we extract from the description appearing in a Swiss contemporary. As its name implies, it is driven by electricity, through the trolley, and the motors are contained within a passenger car. This combination of engine and car gives great weight on the driving wheels; and the cogwheels, by which adhesion is obtained, are the less likely to rise out of the rack, which extends the whole length of the line between the rails.

The frame of the car contains, between the two supporting axles, the two driving axles, on which are the cogwheels. Two electromotors, each of 125 h. p. at 800 revolutions, drive, by means of double reduction gearing, the main cogwheel. The highest output of these motors will be 300 h. p., corresponding to about 285 apparent kilowatts, or about 235 amperes per phase, at a pressure of 500 volts. The gear pinions are of aluminum bronze, the large spur wheels and the driving cogwheels of cast steel. The latter are made as large as possible, in order to have a good grip of the teeth in the rack and as little wear from friction as possible. It is important that a mountain locomotive should be well provided with brakes, and this has three different varieties—an electric brake on the motor shaft available while there is current passing through the motors; a hand brake which acts upon the driving gear; and a third set which acts by gripping the rails, and which is under the control of the conductor as well as the driver. Everything has been done to secure safety and efficiency.

TYPE WRITER RIBBONS.

By ISIDOR FURST.

THE ever recurring query as to reinking type writer ribbons has been kindly referred to me by the editors of this journal.

In treating of this question the second time, I shall endeavor to put whatever knowledge I possess regarding it into such form as will enable any person of average skill to make an ink suitable for any particular style of ribbon and apply it. I mean to illustrate the principles involved and how to meet the various requirements. My reason for doing this, rather than to give a specific formula to be followed in every instance, is that often an experimenter has already produced an ink which lacks only some correction to make it entirely suitable, for "there are many ways leading to Rome." Besides, an ink which may have been suitable at one time may fail at another, under different conditions, and once a person knows how to correct a defect, the ink may be made to answer all purposes.

The constituents of an ink for type writer ribbons may be broadly divided into four elements: 1, the pigment; 2, the vehicle; 3, the corrigent; 4, the solvent. The elements will differ with the kind of ink desired, whether permanent or copying.

Permanent (Record) Ink.—Any finely divided, nonfading color may be used as the pigment, vaseline is the best vehicle, and wax the corrigent. In order to make the ribbon last a long time with one inking, as much pigment as feasible should be used. Suppose we wish to make black record ink. Take some vaseline, melt it on a slow fire or water bath, and incorporate by constant stirring as much lampblack as it will take up without becoming granular. Take from the fire and allow it to cool. The ink is now practically finished, except, if not entirely suitable on trial, it may be improved by adding the corrigent wax in small quantity. The ribbon should be charged with a very thin, evenly divided amount of ink. Hence the necessity of a solvent—in this instance a mixture of equal parts of petroleum benzine and rectified spirit of turpentine. In this mixture dissolve a sufficient amount of the solid ink by vigorous agitation to make a thin paint. Try your ink on one extremity of the ribbon; if too soft, add a little wax to make it harder; if too pale, add more coloring matter; if too hard, add more vaseline. If carefully applied to the ribbon, and the excess brushed off, the result will be satisfactory.

On the same principle, other colors may be made into ink; but for delicate colors, albolene and bleached wax should be the vehicle and corrigent, respectively.

The various printing inks may be used if properly corrected. They require the addition of vaseline to make them non-drying on the ribbon, and of some wax if found too soft. Where printing inks are available, they will be found to give excellent results if thus modified, as the pigment is well milled and finely divided. Even black cosmetic may be made to answer, by the addition of some lampblack to the solution in the mixture of benzine and turpentine.

After thus having explained the principles underlying the manufacture of permanent inks, I can pass more rapidly over the subject of copying inks, which is governed by the same general rules. Personally I am not in favor of the use of copying ink: first, because the print is liable to fade, smear and become invisible; second, because it is unsuitable for legal and other documents of value; third, because it is easier to write two or more copies at one operation with manifold (carbon) paper than to make a second press copy after the writing is done.

For copying inks, aniline colors form the pigment; a mixture of about three parts of water and one part of glycerine, the vehicle; transparent soap (about one-fourth part), the corrigent; stronger alcohol (U. S. P.) (about six parts), the solvent. The desired aniline color will easily dissolve in the hot vehicle, soap will give the ink the necessary body and counteract the hygroscopic tendency of the glycerine, and in the stronger alcohol the ink will readily dissolve, so that it can be applied in a finely divided state to the ribbon, where the evaporation of the alcohol will leave it in a thin film. There is little more to add. After your ink is made and tried—if too soft, add a little more soap; if too hard, a little more glycerine; if too pale, a little more pigment. Probably printer's copying ink can be utilized here likewise, because everyone now has the means to modify and correct it to make it answer the purpose. I have not tried it, because I am opposed to copying inks.

Users of the type writer should so set a fresh ribbon as to start at the edge nearest the operator, allowing it to run back and forth with the same adjustment until exhausted along that strip; then shift the ribbon forward the width of one letter, running until exhausted, and so on. Finally, when the whole ribbon is exhausted, the color will have been equably used up, and on reinking, the work will appear even in color, while it will look patchy if some of the old ink has been left here and there and fresh ink applied over it.

According to the directions here given, I have done nearly all the reinking of my ribbons for more than seven years, and I am sure, if the reader should fail, it will be due to inattention on his part to some of the principles laid down.

We are indebted to the American Druggist for the above particulars.

HISTORY OF TINFOIL.

TINFOIL was invented early in the fifties by John J. Crooke, a young man connected with the drug and chemical trade of New York. Crooke's inventive tendencies led him outside of his regular business, and he endeavored to perfect a method of coating iron bolts with copper, as a substitute for the copper bolts which he saw being used in shipbuilding. In this he was unsuccessful; but it is stated that the experiments led him up to the combining of other metals, and he devised the plan of rolling tin upon lead sheets, producing a sort of weld between the two. Before this the only tinfoil known was pure tin beaten out into sheets as gold leaf is.

A patent was obtained on the invention, and the production of the material was begun at Nos. 355-7 Stanton Street, New York, some pure tinfoil being also made. A business card of this establishment has been preserved, which bears the inscription: "Foil Rolling Mill and Metallic Cap Works; tobacconists'

foil, plain or embossed, tin sheet foil for druggists and bottles, superior to imported article."

The new foil was first used for the wrapping of fine cut tobacco, which had previously been wrapped in paper only. Its advantages for this purpose were obvious, including its sightly appearance and its property of keeping the tobacco moist.

The printing or stamping of names and designs upon the foil was a speedy outgrowth of its manufacture, which was stimulated, after the imposition of internal revenue in war times, by the printing of the internal revenue stamp directly upon the tobacco wrappers. A contract for this work was obtained by Mr. Crooke from the government after many complaints of fraud and loss to the revenue through difficulties connected with the use of paper stamps.

Vast quantities of the foil are used for the packing of domestic Limburger cheese, the material being sent to the Northwestern States for that purpose by the car load. The wrapping of cigarettes in tinfoil is a comparatively new development, the importance of which is manifest when the extent of cigarette manufacture is considered. About one-half of the output of the Crooke factory is rolled pure tin, as the proprietors always boast that only this shall be used when the foil wrapping is to be directly in contact with food. Large amounts are taken for the packing of yeast cakes and also for fancy cheese and other food products of the "delicatessen" order. A great demand for the pure tin comes from the manufacturers of plug tobacco, who use it for the wrapping of the separate plugs and also in sheets between layers of the tobacco. When a machine for packing tobacco was invented, which required tinfoil and paper to be fed into it altogether, a process was devised by which the foil was furnished already backed with thin paper and firmly adhering to it. The pure tin, by the way, is not used for the Limburger cheese wrappings, but the foil of tin and lead, as there is an inner wrapper of paper. Besides, it is probably thought that nothing could hurt Limburger anyway.

The embossing of the foil in various ornamental designs is a branch of the business which has gradually developed until now highly artistic results are obtained. In the fancy patterns, the silvery surface is diversified in bright and "dead" effects, by stars, plaids, flowers, bars, diagonals, lines, etc. Many samples are printed in colors, such as pink, blue and red, both the colors and the patterns being produced by putting the sheets of foil through a process of regular cylinder printing. Other specimens are lacquered with gold and embossed in various forms, presenting a beautiful appearance, and still others are brilliantly lacquered in colors. Confectioners, druggists, cigar manufacturers and cigar box makers use quantities of these fancy designs, many of which are specially made for particular firms and serve as a sort of trade mark. The thickness, or rather the thinness, of the foil runs from 0·0005" upward, the thinnest being the most expensive, as representing the most labor. It is rolled in sheets, which on the average are 50' long and 5¼" wide (some also being rolled as wide as 12"), and is then cut into the lengths desired.

The makers of bottle caps are not classed with the tinfoil manufacturers, as these caps are not made of the regular foil, but are spun on a lathe from a mixture of lead and tin. Besides the John J. Crooke Company there are now four tinfoil factories in this country, two in New York, one in Philadelphia, and one in St. Louis. These four were started after the expiration of the original Crooke patent. The foil is also made in England, France and Germany, its production being especially large in the last named country. Owing to the impossibility of competing with foreign labor in its manufacture, the United States has no export trade in the article, except a little to Havana, where it is used in the packing of cigars.

The output of tinfoil in this country amounts to millions of pounds a year, but there are no data accessible on which to base exact or even approximate figures. The market price of the most expensive embossed and lacquered foils runs as high as 75 cents a pound, and from that it goes down so low that manufacturers do not care to quote the minimum rates. It is said that the average price has been reduced one-half within the last fifteen or twenty years, being lower now than ever before since the foil was invented. This was due to increased facilities of manufacture, increased production, and, especially, keen competition, particularly in the lower grades of the product.

There is constant improvement in the machinery and processes of tinfoil making and also in the article turned out. New uses for it are discovered yearly. Its chief merits as a wrapping are its pleasing appearance, its adaptability to ornamentation, its keeping in place as paper, and above all, its preservation of the contents from drying.—Tin and Terne.

HOT SODA WATER FOUNTAIN FOOD PREPARATIONS.

Bouillon.

Extract beef .... 3 ounces.
Water .... 2 pints.
Corn starch .... 1½ ounces.
Salt .... 2 "

Boil the corn starch with the water until the starch is thoroughly cooked; then add the extract of beef dissolved in 8 ounces of hot water; add the salt, and when dissolved make the finished product measure 2½ pints. To draw this use about 1 ounce to a 8 ounce mug and flavor with a few drops of a flavoring essence composed of tincture of summer savory, 3 ounces, and tincture capsicum, 2 drachms.

Hot Tomato Bouillon.

Beef extract .... ½ to 1 teaspoonful.
Or
Liquid beef extract ..... about 1 fl. ounce.
Tomato catsup ..... about ½ "
Hot water, enough to fill an 8 ounce mug.
Season to taste.

Beef and Celery.

Liebig's extract of beef .... 8 ounces.
Hot water .... 1 pint.
Extract of celery .... 1 drachm.
Caramel .... 1 "

Mix beef in hot water, add celery and color, use a shaker top in the bottle, as there is a sediment in the beef extract which necessitates shaking. In a six or seven ounce cup shake about two teaspoonfuls of the beef extract prepared as above, draw on this sufficient hot water, add salt to suit taste, stir with a spoon, shake a little white pepper on top.

Hot Clam Shake.

Clam juice .... 2 ounces.
Hot milk .... 4 "

Shake well, add pepper and salt, stir well and serve.

Hot Clam Bouillon.

Clam juice .... 1 ounce.

Fill mug with hot soda, add pepper and salt, stir well and serve.

Hot Clam Broth.

Clam juice .... 1½ ounces.
Hot Milk .... 2 "

Fill mug with hot soda, add a sprinkle of salt and white pepper, stir well and serve.

Hot Ginger Clam Broth.

Powdered Jamaica ginger .... 1 teaspoonful.
Cream .... 1 ounce.
Clam bouillon .... 1 "
Butter, sufficient quantity.
Celery salt, sufficient quantity.

Fill mug with hot soda, stir well and serve.

Mock Turtle Extract.

Extract of beef .... 2 ounces.
Concentrated chicken .... 2 "
Clam juice .... 8 "
Hot water .... 3 pints.
Tincture of black pepper .... 1 ounce.
Essence of celery .... 3 drachms.
Essence of orange peel .... 1 "

Mix and dissolve thoroughly. To dispense.

Mock Turtle Bouillon.

Mock turtle extract .... 2 ounces.
Sweet cream .... ½ "

Stir while adding hot soda. Serve spices. (Bonham's Guide).—Pharmaceutical Era.

DISINFECTANT SOAPS.

MR. S. RIDEAL, D.Sc., scores a good point in his paper on this subject, read before the British Pharmaceutical Conference (Pharmaceutical Journal), and contending that although our knowledge of disinfectants has much increased, very little progress has been made with disinfectant soaps, many of those which have been in use for years having little germicidal power. Many valuable disinfectants are quite unfit for use in soaps.

The conditions under which a disinfectant soap acts are very different to an ordinary disinfectant. The time of contact is less, and also the volume of water, and the disinfectant to be effective must be readily soluble in water.

With essential oils and coal-tar products, although emulsified by the soap, their effect is uncertain in soaps, owing to the length of time necessary to produce the death of the most resisting of the organisms.

A base of oleate is preferable to one of stearate or palmitate, as sodium stearate or palmitate is thrown down by hot water (F. Krafft and A. Stern).

Some experiments are required on a basis consisting of soda and potash soaps mixed. Unna suggests that medicaments are more easily absorbed if the soap be superfatted, but for use with disinfectants an excess of alkali is preferable, as fats retard disinfectant properties. Lenti showed that fatty solutions are unsuitable bases for disinfectants. Dr. Breslauer has confirmed this, lanolin being the least objectionable as a basis. Oils and fats for ointments and soaps should be sterilized by heat, as they often contain germs. This is usually done in process of manufacture.

Soaps have considerable disinfectant power, and the action is more marked with cold than with hot water. Prolonged contact with soap renders surfaces practically sterile.

Acids and halogens are obviously unsuited for soaps. Hypochlorites are compatible to a certain extent.

Fluorides and silico-fluorides were found by Thompson to be strongly antiseptic, and they are compatible with soap.

Sulphur and alkaline sulphides blend well with soap, and are useful in skin diseases; but sulphur is slow in action on account of its insolubility. Alkaline sulphides are caustic, and recently ichthyol has been suggested. Most of these gradually evolve H_2S, and are not popular.

Boric acid would be converted into borate, and have little value.

Metallic salts, except Na and K, are precipitated in an insoluble form.

Oleates.—These have been proposed for soaps, but as the oleates of most metals are insoluble in water, it is a question how far an oxide or oleate can be used for washing. Zinc hydrate boiled with sodium to form sodium zincate as neutral as possible, incorporated with yellow soap, showed no sign of separation of insoluble oleate.

Manganese soap is said to be strongly siccative. It is made by decomposing manganese sulphate with soap.

Arsenical Soaps.—The small quantity of arsenic present is useless for antiseptic purposes, but in constant use might have some effect on the skin.

Mercury Soaps.—It is difficult to prevent the formation of mercuric oleate, which is insoluble and of little value. The double iodide of K and Hg has stronger germicidal powers than $HgCl_2$. It is easily incorporated with soap, and there is no separation when dissolved in warm water. The strength recommended is one-third of HgI_2 and one-third of KI in 100 of soap. It is said to be effective in the proportion of one part of HgI_2 in 4000 of water. A soap of this kind which is on the market contains more KI than is sufficient to form the double salt. Potassio mercuric iodide is compatible with strong alkalies, does not precipitate albumen, and is not easily reduced. The carbolate of mercury soap is not so powerful, and is slower in action. Dr. Rideal concludes that a metal in the form of an oleate is readily absorbed by the skin, and that oleate soap would be useful if an internal effect is required, but for local antiseptic or disinfectant purposes the metal must be presented in a soluble form to water, as in the zinc soap mentioned above, or mercuric iodide soap. This is the natural use for soap; the other action more properly belongs to the ointment.

Carbolic and Cresylic Soaps.—The odor of these soaps is an objection. A number of toilet soaps are advertised in conjunction with the names of disinfectants, but contain so small a quantity as to be quite useless as germicides.

Essential Oils.—The disinfectant powers of essential oil have been much overrated, and are often irritating when used in disinfecting quantities. When such ingredients are added to the "crutching pan," it is always necessary to neutralize the free alkali at this stage by the ammonium salt process, or to postpone the addition of the oils until after the operation of fitting. Volatile disinfectants, such as phenol, camphor, thymol, etc., suffer considerable loss if introduced in crutching in the ordinary manner, or added during remelting, so that the quantity present becomes uncertain. Such medicinal soaps should be milled or plotted. The cakes should be packed in tinfoil (mercury soaps in oiled paper or guttapercha tissue). It has been suggested to coat the surface of the cakes with gelatin.

In a series of experiments made in 1896, using two per cent. solutions and broth cultures at 37° C. of two representative organisms, Dr. Rideal found soap with oil of cloves to have little antiseptic action, scarcely exceeding that of curd soap. Carbolic soap (3 lb. per cwt.) was about the same. A series of experiments, not yet complete, shows at present the following results with B. coli communis and two per cent. solutions.

Curd soap, sterile between one and three hours.

Zinc soap (made as described in paper), alive after three hours.

Carbolic soap, sterile between one-quarter and one hour.

Coal tar soap, sterile between one quarter and one hour.

Sanitas soap, alive after three hours.

Terebene soap, alive after three hours.

The variations in these are due to the varying amount of water present.

IRON AND STEEL PRODUCTION IN FRANCE.

SOME official returns have just been issued regarding the metallurgical production in France during the first half of the current year, from which we compile the following few brief particulars. The returns show that the total output of pig iron in the country during that period amounted to 1,223,638 tons, or an increase of 77,044 tons over the first half of 1896. The production of forge pig is returned at 977,719 tons, as against 893,909 tons in the first six months of 1896, and of foundry pig 245,919 tons, as compared with 252,685 tons.

Meurthe-et-Moselle continues to be by far the leading French pig iron producing center, this district being responsible, during the first half of the current year, for 761,199 tons, as compared with 719,961 in 1896, or considerably more than half of the total output in the country.

The second principal district is the Nord, where the output of crude metal for the six months totaled 143,000 tons, while in the Gard the production increased from only 18,851 tons in the first six months of 1896 to 26,422 tons this year.

As regards the finished iron trade the output, as will be seen from the following table, has declined, as compared with the second half of last year, to the extent of 17,281 tons, although it is 14,030 tons better than was recorded in the first six months of 1896:

	Jan.-June. 1897. Tons.	July-Dec. 1896. Tons.	Jan.-June. 1896. Tons.
Iron bars	369,747	376,172	347,885
" rails	372	459	417
" plates and sheets	35,577	46,346	43,364
Total	405,696	422,977	391,666

In this branch the Nord continues to occupy the leading position, with 152,610 tons, as against 141,731 tons in the past six months of last year, followed by the Ardennes, where the production, however, increased but slightly from 47,012 tons in 1896 to 48,555 tons in 1897.

The steady progress in the steel trade has been well maintained, the production during the period under review showing, as given below, a satisfactory increase over both the two preceding half years:

	Jan.-June. 1897. Tons.	July-Dec. 1896. Tons.	Jan.-June. 1896. Tons.
Steel bars	270,952	283,020	218,042
" rails	95,426	82,286	88,389
" plates and sheets	108,440	105,666	106,105
Total	474,818	470,972	412,536

In both the Nord, the Meurthe-et-Moselle and the Saône-et-Loire districts the output of steel is undergoing a steady development. The Nord leads the list with 96,245 tons for the six months as compared with 71,548 tons in the first half of 1896, or an increase of roundly 24,000 tons, while in the Meurthe-et-Moselle the output totaled 61,747 tons, as against 56,943 tons.—Colliery Guardian.

One of the nicest ways to draw temper on a long, slender tool, like a stay bolt tap, is to use a piece of gas pipe. Run the pipe through the fire, making the fire long enough to accommodate it, and put in your tap, turning it and watching it, and you can get the nicest sort of heat. Some tool hardeners do their heating to harden in a pipe. Where much of this kind of work is to be done, the device can be improved, as, for instance, by the use of permanent supports for the pipe. Smiths are prolific in rigging up devices and can easily extend and elaborate the idea.—Sparks.

ELECTRICAL NOTES.

An isolated electric plant was recently installed in a large tea firing or curing establishment in Yokohama. This establishment employs 2,000 people, who clean and sort the tea by native fan blowing and sifting machinery, after which it is taken to the firing rooms, containing 1,500 pots, set in brick work and heated by a slow fire, the tea being stirred continuously by the coolie who attends each pot, the work going on day and night during the busy season.—Philadelphia Record.

At present there are in use in America from 150 to 200 miles of street railway track the joints of which have been all welded, either by the electrical or the "cast welding" system, so that the rails are actually continuous. As to the success of this system, the testimony is rather conflicting; but the fact appears to be that the difficulties encountered have been no more serious than might naturally be expected to accompany so novel a departure from usual practice. The cast welding system promises to supersede the electric welding system, says The Engineering News, because it produces as good or better results at a less cost. Unless some further trouble should develop, or those already found should prove more serious than they thus far have done, it seems quite probable that the street railway track of the future will have a continuous rail, at least wherever it is laid in paved streets.

The possibility of finding for aluminum a wide field of usefulness as an electric conductor has very frequently been discussed—not without hope on the part of the producers of the new metal—but there have not been sufficiently reliable data, the tests of the conductivity of aluminum as compared with copper showing a very low result. This, it has now been proved, is due to the fact that the aluminum tried had been impure, a small percentage of foreign element making a material difference. Some very careful tests have been made on behalf of one of the American technical institutes (the Franklin), and these show very favorable results. Thus aluminum with 1·5 per cent. of impurities was found to have little more than one-half of the conductivity of copper, or 55 per cent.; while, when the impurities were reduced to 1 per cent., the conductivity increased to 59 per cent. that of copper; with ½ or 0·5 per cent. of impurities the conductivity became 61 per cent.; and with absolutely pure aluminum it was found that copper was only one-third more powerful as a conductor, or that it was a case of 67 for aluminum against 100 for copper. The question therefore arises as to whether pure aluminum can be produced 33 per cent. more cheaply than copper of the same capacity. There seems every reason to believe that it can be. The same research committee found that the conductivity of hard drawn commercial aluminum was nearly 1 per cent. higher when annealed.

An interesting paper by Trabert, on the crackling of the telephone on the Sonnblick, appears in the fourth report of the Sonnblick Verein. The Sonnblick, it may be stated, is one of the best known mountain observatories in the world, by reason of its height (10,154 feet), and especially by reason of the valuable results which have been derived by Hann and others from the observations there made. For six years, says Science, five observations a day have been made of the intensity of the crackling in the telephone at the summit. It appears from these data that in December the minimum crackling is at noon, with the maximum at 9 P. M., and a secondary maximum at 7 A. M., while in June there is a steady increase in the intensity of the noise from 7 A. M. to 9 P. M., without a noon minimum. The other months of winter and summer follow respectively the same rule as December and June, while the intermediate months, as expected, present the intermediate conditions. Further, the noise is greater in summer than in winter. Regarding the explanation of these phenomena, the author finds it chiefly in the presence of atmospheric electricity in the clouds over the Sonnblick, for there is a very striking correspondence between the crackling and the cloudiness on the summit, not only in the diurnal period, but in the annual as well. The days on which there is the greatest intensity of crackling are almost invariably distinguished by cloudiness, rain, snow or thunderstorms. The part played by earth currents must not be overlooked, for on one cloudless anticyclonic day there was a very well marked crackling, which could not be explained as being due to atmospheric electricity.

Some statistics on lightning strokes compiled by the war ministry of Austria-Hungary may at first glance appear rather puzzling, says The Trade Journals Review. They refer exclusively to fortifications and buildings under this department. During 1893 there were 7,979 such buildings, in 3,642 groups. Of these, 1,086 were provided with lightning protectors; the far greater number of 6,893 buildings were without conductors. Forty-two buildings were struck; 29 of those were protected. That is to say, 2·67 per cent. of the protected buildings were struck and only 0·40 per cent. of the unprotected. In 1894 those percentages were 3·25 and 0·087; in 1895, 7·41 and 0·086. The increase in 1895 looks very peculiar; but it turns out that this increase concerns only one district, that of Cattaro, in Dalmatia, where thunderstorms are always frequent, and that on the whole the year 1895 was not exceptional in thunderstorms. Then there is the very marked preference of lightning for protected buildings, which seems to suggest that conductors are worse than useless. The statistics comprise, however, all cases where lightning has taken the path provided for it, and on the whole they prove that the conductors have done their duty. Without going into technical details, the able analysis of the statistics by Dr. Wächter, in the Mittheilungen des Artillerie und Genie Wesens, establishes that, whatever be the theory of lightning conductors, we are not wrong in fitting exposed buildings with conductors joined to the underground water. The old-fashioned plates, buried in holes packed with coke, failed in many instances. The preference of lightning for certain conductors, some of which were struck, several up to 21 times, simply proves that the conductors were placed in suitable places. The present paper does not deal with different types of conductors, these having been discussed by Col. Hess in 1889.

MISCELLANEOUS NOTES.

Trondhjem, the ancient capital of the Norwegian kings, is celebrating the 900th anniversary of its foundation.

The directors of the Furness Railway Company have decided to abolish second class passenger accommodation; but supplementary reserved tickets will be issued to holders of third class tickets at a small extra charge. The carriages will be labeled "Reserved tickets." This is an entirely new departure in the conduct of railway passenger business.

It appears that from the town of Lee, in western Massachusetts, come some of the strongest marbles in the world, as they are found equal to bearing a weight of 13,460 pounds to the cubic inch; but the strongest American limestone comes from Kingston, N. Y., showing a capacity to stand 13,900 pounds pressure to the cubic inch. Tuckahoe marble will bear 12,950 pounds to the cubic inch, this being more than the well known red granite of the Bay of Fundy region, the limit of this latter material being 11,813. The trap rocks of New Jersey and the dolomites of Staten Island are rated the strongest stones in the United States, their crushing resistance being 24,000 pounds to the cubic inch. Rhode Island granite crushes at 17,750 pounds to the cubic inch, that of Virginia will bear 21,500 pounds, and that from the quarries of Maryland 19,750 pounds. New England granites, in general, vary somewhat from these standards.

The Paris correspondent of the British Medical Journal mentions a curious case reported to a Bordeaux society by Dr. Ginestos. The subject was a young man who has, since the age of ten years, had an irresistible impulse to count the letters contained in a word or phrase that he hears, sees, speaks, or thinks. This habit is practiced from the time he wakes to the time he goes to sleep. At night he sleeps without dreaming. When he does not talk, he invents phrases and counts the letters in them. Thirty-two is a number which gives him satisfaction; thirteen displeases him, but nevertheless he does not recoil from arranging phrases with thirteen letters. This unceasing automatic operation does not in any way interfere with his daily work, or reading, or carrying on a conversation. Unless previously informed it would be impossible and extremely difficult for any one to detect the silent mental labor the young man—he is now twenty-seven—is always engaged in.

Colored glasses are generally produced by fusing oxides with the glass; the whole mass is colored. Léon Lémal colors the surface by penetration, and obtains, according to La Nature, colored patterns of striking novelty. A bit of silver salt is placed on the glass, and the glass heated up to 500° or 550° C.; the excess of salt having been removed, the surface will appear of a more or less deep yellow. The depth to which the color penetrates depends upon the time, the shade upon the quantity of salt applied. In five minutes, the top layer of glass, 0·17 millimeter in thickness, was colored; after an hour, that thickness was doubled; in eighteen hours, a plate 1·6 millimeter (1/16 inch) thick was colored throughout. The color appears both in reflected and transparent light, and the yellow is said to be distinguished by a fine greenish or bluish fluorescence. Other metallic salts can be used, gold, copper, iron; silver with a little copper gives a red. The process is exceedingly simple. To transfer a lace pattern upon glass, it suffices to dip the lace into very diluted solution of nitrate of silver and then into potassium sulphide. Photographic collodion negatives can be directly applied to the surface.

In a paper on "The Use of Wind Power in Village Water Supply," in the Journal of the Royal Agricultural Society, of England, Mr. A. L. Y. Morley describes the method which has been successfully pursued in securing an adequate and constant supply of water in two adjoining villages on Lord Spencer's estate in Northamptonshire. The supply of water is obtained from a depth of 200 feet, and is pumped by means of one of Titt's simplex wind engines into a reservoir on the side of the hill, from which at 465 feet above the sea level the water flows to the various points of consumption by natural gravitation. The reservoir is a double one with a capacity of 180,000 gallons. The winter consumption is about 5,000 gallons per day, but in summer when stock are at pasture about 1,000 gallons extra are needed. A population of some 600 people is supplied with water all the year round, and the standards, by Guest and Chrimes, from which the water is drawn, are ingeniously arranged so as to avoid waste through carelessness on the one hand and obstruction from frost on the other. The cost of the reservoir was £530, and of the wind engine £275, the total cost of the entire works, including the considerable lengths of iron piping required, being £2,350. During the four years the works have been in operation there has never been the least anxiety lest the water supply should give out through failure of wind power.

An English journal states that "Australia is going to give us a surprise in the shape of a consignment of two tons of sample tobacco which are now stored at Wangaratta awaiting a touch of humidity in the final stage of treatment before being shipped to England. The Victorian Agricultural Department is sending it on, and it will be packed in the American style, in hogsheads of half a hundredweight each. In quality it is said to be like the tobacco of Kentucky, Missouri and Ohio, and more Western States, rather than like that of Virginia, but it would not necessarily be inferior on that account, especially if the comparison should apply to the Maryland growth, which is the prime favorite in the States. However, there is a wide scale of prices as there is a wide range of qualities. Virginia leaf realizes here all the way from 3d. to 7d. per pound, bright leaf from 4d. to 14½d. per pound, dark Virginia stripped leaf (with the stalks taken out) from 4d. to 10d. per pound, and bright leaf stripped from 4½d. to 15½d. per pound. The Victorian article is a medium colored leaf, the dark and light qualities being intermixed. Heavy dark tobacco, with which the Victorian leaf will probably rank, fetches in the English market 7d. to 8d. per pound for prime, while stripped Western brings 7½d. to 8d., short to middling 5d. to 6d. and the lowest grades from 2½d. to 4d. per pound. If the tobacco from the antipodes turns out satisfactory, the prices realized will no doubt be found equally so."

SELECTED FORMULÆ.

Inking Typewriter Ribbons.—Take vaseline (petrolatum) of high boiling point, melt it on a water bath or slow fire, and incorporate by constant stirring as much lamp or powdered drop black as it will take up without becoming granular. If the vaseline remains in excess, the print is liable to have a greasy outline; if the color is in excess, the print will not be clear. Remove the mixture from the fire, and while it is cooling mix equal parts of petroleum benzine and rectified oil of turpentine, in which dissolve the fatty ink, introduced in small portions, by constant agitation. The volatile solvents should be in such quantity that the fluid ink is of the consistence of fresh oil paint. One secret of success lies in the proper application of the ink to the ribbon. Wind the ribbon on a piece of cardboard, spread on a table several layers of newspaper, then unwind the ribbon in such lengths as may be most convenient, and lay it flat on the paper. Apply the ink, after agitation, by means of a soft brush, and rub it well into the interstices of the ribbon with a tooth brush. Hardly any ink should remain visible on the surface. For colored inks use Prussian blue, red lead, etc., and especially the aniline colors.

Aniline black	½	ounce.
Pure alcohol	15	"
Concentrated glycerine	15	"

Dissolve the aniline black in the alcohol, and add the glycerine. Ink as before. The aniline inks containing glycerine are copying inks.

To Remove Oil and Grease Spots from Colored Leather.—One of the most annoying things in shoemaking is grease spots on colored leather, and the numerous inquiries as to how to remove them show that they occur only too often. We, therefore, believe the trade will learn with interest that, after innumerable experiments, costing much time and money, a means has been found for removing grease spots from leather without changing its color.

Any one who has tried to clean spotted leather by known processes will have become convinced that they are all defective. The use of chalk is complicated, and requires a great deal of time. Spirits of wine injures the color; benzine does the same, with the addition that it attacks at the same time the fatty substances necessary to preserve the fiber of the leather, thus being doubly injurious. Applying hot iron over the grease spot, after covering it with blotting paper, offers no sure result. So other means had to be sought for. Thus it was that finally a solution of gutta percha was tried, with surprising results.

It is true that at first some failures were recorded, but these were due to the employment of benzine as a solvent. There was no doubt that the solution of gutta percha in benzine would remove the grease; but all around the place where the mixture had been applied, a dark circle still remained to show the spot.

Finally, a solution of gutta percha was prepared by pouring carbon bisulphide into a bottle of suitable size, containing the non-vulcanized gum, and allowing it to stand about twenty-four hours. The solution is moderately liquid, and, after shaking it actively several times more, rubber is gradually added, until the solution becomes of gelatinous consistency. This mixture was applied in suitable quantity to colored leather which had been smeared in fish oil, and allowed to dry two or three hours. The subsequent operation consists merely in removing the coat of gum from the surface of the leather—that is, rubbing it with the fingers, and rolling it off the surface.

The color is not injured in the least by the sulphuret of carbon; only those leathers on which a dressing containing starch has been used look a little lighter in color, but the better class of leathers are not so dressed. As to the dried gum, it can be redissolved in sulphuret of carbon and used over again.

The new process consists, then, simply of the application of a very stiff solution of gutta percha in carbon bisulphide, forming a coating of from one-fourth to one-half centimeter thick over the grease spot, leaving it to dry; and afterward removing it. As the gum can be used over and over again, and only the carbon bisulphide has to be supplied, the process is very economical.—From Neue Wiener Schuhmacher-Zeitung.

Blue-Black Ink.—

Aleppo nut galls "blue"	4½	ounces.
Cloves bruised	⅛	"
Cold water	40	"
Ferrous sulphate (purified crystals)	1½	"
Sulphuric acid	35	drops.
Sulphate of indigo	¼	ounce.

Macerate the nut galls and cloves in the water during a fortnight; then press and strain through a cloth filter, add the ferrous sulphate previously powdered, dissolve, and add the acid and indigo solution. Shake or stir the mixture well; then set it aside for a week, and filter it. The nut galls should be free from insect perforations. The sulphate of indigo should be used in the form of a thinnish paste, neutral or nearly so.—Pharmaceutical Era.

A Means of Polishing Machinery.—The chemical laboratory of the industrial museum of Batavia recommends a mixture of—

Oil of turpentine	15	parts.
Oil of stearine	25	"
Jeweler's red	25	"
Animal charcoal, of superior quality	45	"

Alcohol is added to that mixture in such a quantity as to render it almost liquid, then by means of a brush it is put on those parts that are to be polished. When the alcohol has dried, the remaining cover is rubbed with a mixture of 45 parts animal charcoal and 25 parts jeweler's red. The rubbed parts will become quite clean and bright.

Solution for Removing Nitrate of Silver Spots.—

Bichloride of mercury	5·0	grammes.
Ammonium chloride	5·0	"
Distilled water	40·0	"

Apply the mixture to the spots with a cloth, then rub. This removes almost instantaneously even ancient stains on linen, cotton or wool. Skin stains thus treated become whitish yellow and soon disappear.—Mntsch. f. Prakt. Derm.

THE ELECTRIC TRANSPORTATION SYSTEM OF FAIRMOUNT PARK, PHILADELPHIA.

ONE of the most interesting and novel electric lines in this country is that recently installed within the confines of Fairmount Park, Philadelphia. This attractive park is the largest and most important of the public pleasure resorts in Philadelphia, and in fact is the largest public city park in the world and covers 2,740 acres. It is attractively located on both sides of the Schuylkill River, which divides West Philadelphia from the older part of the city, and is quite accessible from the latter, the entrance at Twenty-fifth and Spring Garden Streets being only about a mile in a direct line from the City Hall. The park is noted for natural attractions and artificial improvements, as well as for its extent, in all of which it ranks among the first in the world among similar undertakings.

Although traversed by many fine carriage drives and walks, the very size of the park, which, like the city, was laid out with exceedingly generous proportions, has made many portions of it inaccessible to all except sturdy pedestrians or those who could drive or ride to the points furthest distant from the entrances. In this way many of the most beautiful localities within its borders have been practically unknown to the large mass of citizens; but the proposals which have been made from time to time heretofore to open these portions to visitors by means of a railway have always been defeated, owing to the fear that the construction of a transportation system would destroy or seriously injure the natural attractiveness of the park. The subject was again taken up, however, several years ago, and plans were prepared showing how an electric line making a circuit in the park could be built without a great destruction of the natural scenery, and after much debate among the park commissioners a franchise for such a line was finally granted the Fairmount Park Transportation Company. The result is so at variance with the popular idea that a railroad line, and particularly a trolley road, is necessarily conspicuous and must detract in a park from the natural scenery, that a description of the methods by which the results are reached will be of interest.

On reaching the park the visitor's first surprise is to find the cars standing on the edge of the lawn with almost nothing suggesting a railway in sight. While the usual overhead work is in place, it is not conspicuous, owing to the openness of its surroundings, while on the ground only two rail heads are seen stretching away through the grass. The space between the rails is completely filled in and sown with grass. The element of danger is eliminated by avoiding, from one end of the park to the other, every grade crossing of even a foot path. The line dips sharply under many of the carriage ways; it winds along valleys, clings to the hillsides, follows up and down ravines, and is as utterly unobtrusive as two lines of iron could be on the landscape. Conforming so closely to the contour of the land, there are few embankments or cuttings that are even noticeable features in the landscape until one is close upon them. Even the power station and car house are hidden from sight, as will be described later.

The line has a length of 8¼ miles, along which stations are constructed at distances of about three-quarters of a mile apart, and at these stations only are passengers allowed to enter or leave the cars. The road being in the form of a loop, the cars run in one direction only. For short distances at the southern and eastern ends the tracks lie parallel, but for the remainder of the distance they are widely separated. The whole line is inclosed by a wire fence of twisted steel. The track is laid with 90 lb. T rail laid on yellow pine ties 6 in. × 8 in. × 8 ft. in size and spaced 2 ft. centers. The rails are bonded with the Brown plastic bond. All switches are of standard steam railroad pattern. As all banks and cuts are sodded with grass, they are of a different slope than is usual. Those on banks and cuts less than 10 ft. deep are proportioned as one to three, and on cuts or banks more than 10 ft. in depth the proportion is one to two.

In preventing grade crossings over drives and pathways, the company has constructed a number of viaducts, stone arches and iron bridges, the total number of which is twenty, including a bridge over the Schuylkill River, which is 227 ft. long. This bridge has a double track for the railway, a 40 ft. wide carriage drive and a 12 ft. wide sidewalk. The height from the drive to low water is 80 ft. This bridge has four river arched spans each 208 ft. long.

The rolling stock consists of sixty cars, ten of which are closed motor cars. Of the fifty open cars, twenty are fitted with motors and the remainder are trailers. All the cars are of unusual width, being 7 ft. 10 in. in the clear at the seats. The gage is 5 ft. 2½ in. The closed cars have 32 ft. bodies and are 42 ft. over all. They are 8 ft. 9¼ in. wide at the posts. These cars seat forty-eight passengers in cross seats, which are 35 in. long and have a 21 in. aisle between them.

The open cars were also specially designed for the service and differ essentially from other cars of a similar type. In length they measure 47 ft. over the crown pieces or 38 ft. at the corner posts. The width over the posts is 8 ft. 10 in. This gives a long seat which accommodates six persons comfortably. As the seats are spaced 3 ft. in the clear, ample room is given those entering or leaving a seat. The spaces are the same as those in the Broadway cars in New York City, and in the case of a crowd there is ample standing room for a row of people in front of those who are sitting. There are eight reversible seats and four with stationary backs, giving a seating capacity of seventy-two.

The cars are mounted upon 27-B trucks, a modified form of the "Perfect truck" of the same firm. These trucks are equalized, and have a swing motion which is cushioned by means of springs within the swinging links. This feature makes them very easy and steady on curves even when going at a high rate of speed. A long elliptic spring on each side is so arranged as to take the place of the equalizer.

They give a short wheel base, bring the body of the car low and do not kick up under the action of brakes. This road tests the riding qualities of the cars most severely, as it is full of curves, many of them of quite short radius. Under these conditions the trucks are riding with remarkable ease and smoothness.

The electrical equipment consists of four motors to a car and electric brakes acting on all axles, on the trailer cars as well as the motor cars. The cars are equipped with G. E. 1,000 motors and controllers, specially manufactured for the Fairmount Park Transportation Company, controlling both motors and brakes. The operation of the road is protected with the Hall block signal system.

The overhead construction work of this line is one of the most substantial in the country and is of a peculiar nature, owing to the heavy traffic and the location of the road through a series of rock and clay cuts, over high earth embankments and through and over stone and iron viaducts.

Over 60 per cent. of the poles are set in solid rock and about 15 per cent. are of special lengths and construction, varying all the way from a 28 ft. pole, weighing 750 lb., to a pole 65 ft. long, weighing 2,800 lb. There are three standard weights of poles on the line—on straight track a 7 in. by 6 in. by 5 in. 28 ft. pole, weighing 750 lb.; for pull-offs and special strains a 1,000 lb. pole of same dimensions, and for special strains, at the end of the line, an 8 in. by 7 in. by 6 in. 28 ft. pole, weighing 1,800 lb. The poles are set in concrete 6 ft. deep, in 2 ft. diameter holes. On straight track, poles are spaced 100 ft. apart and on curves 50 ft. apart.

The span wires are $\frac{7}{16}$ in. diameter steel cable, insulated from poles by special heavy Macallan turnbuckles. The trolley wire is attached to the span wire through a special cap and cone insulator. The trolley wire is a No. 0000, and it is held in the insulators by soldered ears weighing a little over double the standard weight ear used on No. 00 construction work. The wire is spliced with heavy copper sleeves. All feeder taps are provided with 600 ampere single switches, heavy line breaks and General Electric Company's lightning arresters. On double track the trolley wires are cross connected every 1,000 ft. Under bridges, of which there are a large number, the trolley wire is secured in heavy yellow pine troughs with standard cap and cone barn hangers. All curve work is of exceptionally heavy construction, owing to the use of heavy No. 0000 trolley wire and the constant traffic.

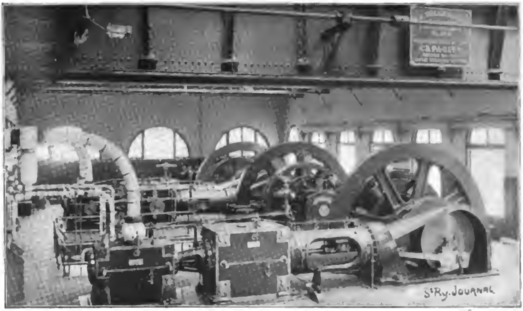
The feeders are underground and are laid in 2¼ in. Williamsport creosoted wooden ducts. Roebling paper covered feeders are used. This feeder system runs across a number of valleys containing streams of water and many of the manholes are 20 ft. deep. The contractors for the overhead and underground systems were Pepper & Register. Mayer & Englund supplied the overhead appliances.

A short distance below the car house is situated the engine and boiler house. This building was designed by Axel H. Engstrom and Edw. B. Ives, and is also much below the surrounding level. The stack is only as high as the roof of the house itself, and from a little distance the building is entirely hidden from sight by the tree-covered banks.

The engine room is 156 ft. by 55 ft. in size, and the boiler room of the same length and 36 ft. wide. A spur from the adjacent railroad is carried close to the south wall of the boiler room and passes over coal vaults, the coal being dumped into the vaults by means of chutes. The station has sufficient storage capacity for one month's supply of coal.

At present there are installed three tandem compound condensing Corliss engines, furnished by Robert Wetherill & Company. There is room in the station for two more engines. The engine foundations are of brick and of unusually large proportions. Each foundation rests upon a concrete bed. This bed of concrete is 24 in. in thickness. The engines have cylinders 20 in. and 36 in. by 48 in. in size, and each makes 90 revolutions per minute.

The flywheel is 20 ft. in diameter and weighs 40 tons. It is made in sections, an arm being cast with each rim section. The rim segments are tied together by heavy wrought iron links. Each engine is directly connected to a 300 kilowatt generator, furnished by the General Electric Company.



ENGINES AND GENERATORS—FAIRMOUNT PARK POWER STATION.

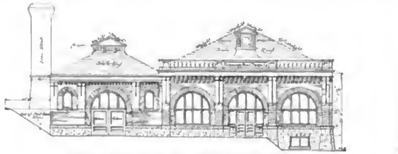
The boiler room at the present time contains six Berry boilers, built by Wetherill & Company, and space has been provided for the installation of two more. Each boiler is of the vertical type, occupies a floor space of 11 ft. by 11 ft. in size, and is rated at 250 horse power. The gases from the boilers pass to an overhead smoke flue leading to two sets of economizers, from which the waste gases are exhausted by a pair of exhaust fans discharging into a short steel stack 7 ft. in diameter. The economizers are so connected to the flues that one set receives the waste gases from the boilers at one end of the boiler room, while the other receives the waste gases from the other boilers. All of the waste gases, however, may be passed through either economizer. A single fan, 10 ft. in diameter and 4 ft. wide, driven by a direct connected engine, exhausts each economizer, and both fans discharge into a common stack. The fans and economizers were furnished by the American Economizer Company. The economizers have 256 pipes each. The sections are eight pipes wide and each pipe is 4½ in. in diameter and 9 ft. 4 in. long. Each economizer has a heating surface of 2,944 ft.

The exhaust steam from the engines passes into a 20 in. exhaust main located under the floor of the engine room. This main is divided into two sections by a 20 in. valve and each section has a pipe leading to a twin vertical air pump made by the George F. Blake Manufacturing Company, connected to a jet condenser. A branch from the exhaust pipe to the condenser 16 in. in size, and fitted with a relief valve, unites with the free exhaust from the other half of the system to form a 20 in. pipe leading to the atmosphere.

The steam cylinders of the air pump are 12 in. in diameter, and the bucket of the air pump, which is single acting, is 25 in. in diameter. Each has a stroke of 18 in. The injection water is taken from the adjacent Schuylkill River through a 16 in. pipe. These mains pass to the condensers in a trench between the two concrete beds underneath the engine foundation;

The discharge from both condensers is 16 in. in size, and leads back to the river.

All of the auxiliaries of the plant, such as the air pumps from the condensers, drip and feed pumps, fans, engines, etc., are supplied by branches from an auxiliary steam main supported from the wall of the engine room. The exhaust steam from all of these auxiliaries is collected into a 6 in. pipe and passed through a Berryman feedwater heater with 1,000 sq. ft. of heating surface from which the surplus exhaust steam passes into the free exhaust pipe from the main engines. The heater, however, may be by-passed if desired. The boiler feedwater may be taken either from the river or from the discharge from the condensers. The water, which is taken from the discharge from the condensers,



SOUTH ELEVATION OF POWER STATION.

is passed through a filter made to remove the oil in order that it may not enter the boilers.

The boiler feed pumps are two in number and the water is forced by them through the feedwater heater, where it is raised to about 200° temperature, and from the heater either directly to the boilers or through the fuel economizers as desired. The fuel economizer may also be by passed if desired.

The cost up to date for the 8¼ miles of line is estimated at $2,000,000, including $500,000 paid for the franchise. To earn returns on this investment a large traffic is, of course, necessary, as the fares are limited to five cents per passenger, independent of the length of ride. The traffic so far has been enormous, and points to a most successful financial return upon the investment. Thirty-five hundred passengers have been carried in one day, the maximum load to the station on this day being 3,400 amperes, while the running expenses were $300.

We are indebted to The Street Railway Journal for cuts and particulars.

THE ECONOMY AND UTILITY OF ELECTRICAL COOKING APPARATUS.*

By JOHN PRICE JACKSON.

THE tests of electrical cooking apparatus detailed in this paper were made with the hope of obtaining a method of cooking that would be satisfactory with a minimum risk of fire. During the past winter a serious fire, which might readily have become disastrous, occurred in one of the buildings of the college with which the writer is connected, caused by the use of an alcohol stove. As this institution is lighted and furnished with power by electricity, it was naturally felt that such a danger should be avoided, if possible, by the use of electrical appliances. It was also desired to ascertain whether at least a portion of the cooking in the woman's department of the college could not be done satisfactorily by electricity.

To determine these points, I procured from the American Electrical Heating Corporation, of Boston, through the courtesy of Mr. J. E. Sayles, the following pieces of apparatus:

One oven, 18" × 9" × 18", having three heats, 3, 10 and 17 amperes respectively.

Three stoves of 2, 4 and 5 amperes respectively.

Two flatirons of 1·5 and 6 amperes capacity.

One broiler of 12 amperes capacity.

One curling iron of ½ ampere capacity.

The pressure used by these is 110 volts.

The stoves are round disks of iron, on the under side of which the heating wires are embedded in a non-conducting, incombustible compound. The oven is a box, so thoroughly heat insulated that the outside metal covering never reaches a temperature uncomfortable to the hand. The broiler is made of a corrugated metal surface, slightly tipped from the horizontal, with a drip groove at the lower edge for catching the meat juices. The flatirons are similar in construction to the stoves, the larger one having a low current switch, which enables the operator to control the heat.

In all these appliances the heating coils are so arranged that the energy is largely concentrated at useful points. They are also supplied with supports and bases which will not conduct heat.

The efficiencies of the two larger stoves were obtained by heating two pounds of water to the boiling point and measuring the power supplied by a calibrated wattmeter. The cooking vessels used were ordinary stewing pans, with the bases nearly of the same size as the tops of the stoves. The efficiencies, considering the ratio between the amount of heat absorbed by the water and the amount received by the stoves, were:

For the larger or No. 1, 48·9 per cent.

For the next size, " 2, 43·1 "

These efficiencies could be increased by having the pans made to fit the stoves exactly, and still further by carefully covering the pans, lids and exposed portions of the stoves with a non conductor of heat.

When it is desired to boil water, the best plan is to place an immersion coil in a properly heat-insulated pot; such an arrangement should give an efficiency of from 90 to 100 per cent. We unluckily did not have such a coil at our disposal.

It was impossible to measure the cooking efficiency of the oven, but as it was merely warm on the outside after potatoes or bread had been baked and "done to a turn," the efficiency is high. In baking, the current was turned on and the oven allowed to heat for five minutes before the articles to be cooked were placed within, and the current was turned off from ten to twenty minutes before the baking was done, when the heat of the oven was sufficient to complete the operation. The broiler was manipulated in much the same manner, thus utilizing the greatest possible amount of heat. This electrical apparatus was used for several weeks in cooking most of the meals for a family of six.

The following table indicates the amount of cooking done for the first breakfast, dinner and supper respectively, and may be taken as a fair average of the whole period.

All costs have been estimated on the basis of 10 cents per kilowatt hour, the average rate charged for residence electrical supply in a near-by town. The foods were not measured, as it was believed more desirable to determine whether in a long period of cooking the apparatus would prove satisfactory for a family of given size.

The largest stove is designated No. 1; the next size, No. 2; the third size, No. 3; the broiler, B, and the oven, O.

BREAKFAST.

Time.	Circuits.	Food.	Watts.
6.55	No. 1, on	Rolled oats	
6.55	2, on	Coffee	811
7.40	1, off		
7.45	B, on	Beefsteak	1500
7.55	2, off		1155
8.05	B, off		

Kilowatt hours, 1.855 Cost, 11·46 cents.

DINNER.

Time.	Circuits.	Food.	Watts.
10.51	No. O, on	Beef, roast	
10.55		Potatoes	1610
11.35		Pie	
11.40	1, on	Asparagus	1000
12.05	O, off		
12.05	2, on	Coffee	1180
12.11	B, on	Toast for aspar.	2200
12.20	1, off		1835
12.32	B, off		
12.33	2, off		

Kilowatt hours, 2·98 Cost, 29·8 cents.

SUPPER.

Time.	Circuits.	Food.	Watts.
4.50	No. 1, on	Cocoa	630
5.15	2, on	Potato cakes	1010
5.16	B, on	Omelet	2100
5.23	2, off		1700
5.26	B, off		
5.26	2, on		1130
5.43	2, off		640
5.44	1, off		

Kilowatt hours, 8·39 Cost, 8·39 cents.

Four pies can be baked in the oven at an expenditure of 0·62 kilowatt hour and a cost 6·2 cents or 2·05 cents per pie. Two large loaves of bread were baked with the current on the oven 50 minutes, at an expenditure of 1·22 kilowatt hours, a cost of 12·2 cents or 6·1 cents per loaf. Four rather small-sized loaves could have been baked as readily. Biscuits with about the same expenditure of energy as in the case of pies. The broiler utilized about the same amount of energy for all kinds of meat as indicated in the table. The cost of soup sufficient for the family was about 4·5 cents.

The result of the whole series of meals was a cost for electricity of 13·1 cents per meal. The heating of water for washing the dishes took an additional 0·35 of a kilowatt hour per meal, which raises the cost to 16·6 cents per meal.

To determine the relative cost of cooking with electricity and coal, the same foods were cooked on the No. 8 Othello coal stove ordinarily used by the family. The coal was carefully weighed. The results gave an average of 12·6 pounds per meal, which at $5 per ton gives a cost of 3·15 cents per meal.

The results show the cost of cooking by coal to be about 19 per cent. of the cost of cooking by electricity.

Ironing was done for the same household a number of times. The heavy articles were done with the large iron; while for fancy dresses and light articles the small iron was used. The average time taken was four hours, and the expenditure of energy in kilowatt hours was 2·27. This made the cost of the ironing 22·7 cents.

An equal number of tests was made using the coal range, the fuel being carefully weighed. For the same sized wash, the ironing took five hours, at a cost of 12·25 cents. This shows the cost of energy by the use of coal to be 54 per cent. of that by electricity.

The results of the cooking tests seem to indicate that for the usual cooking of a family for the whole year the expense would be larger than would be ordinarily acceptable, notwithstanding the great advantages in other respects. However, in the following classes the utility of electrical cooking utensils should be great:

1. For light housekeeping, such as is practiced in small city apartments, and in many larger houses during the summer months, no other method presents so many desirable features. The dirt of coal and ashes, disagreeable gases and abnormal temperature due to a coal stove are entirely avoided. For such housekeeping a disk stove using 500 or 600 watts and a broiler using about 1,200 watts would be sufficient for a small family and would cost from $20 to $30. A teakettle or immersion coil might be added at a cost of from $6 to $10. A special pair of wires would of necessity have to be run into the cooking room from the house or apartment supply mains. The latter would ordinarily warrant the extra call that would be made on them in this way. For similar purposes coal oil, gas or gasoline are frequently used, but with the inherent disadvantages of greater heat in the room, offensive odors, comparative uncleanliness and danger.

2. This form of cooking apparatus could be used with facility in boarding houses and restaurants for purposes that require an even temperature, such as is needed in baking griddle cakes, boiling eggs, etc.

3. Where electricity is available, nothing could be more convenient than a small electrical stove, requiring 300 or 400 watts, for the many uses to which at present the alcohol flame is put, such as the afternoon tea.

TYPICAL PASSENGER STATION—FAIRMOUNT PARK.

ENTRANCE TO ONE OF THE ARCHES.

* A paper presented at the fourteenth general meeting of the American Institute of Electrical Engineers, Eliot, Me., July 28, 1897.

kettle, chafing dish, toaster, etc. This use of alcohol is most unsafe as regards danger from fire, and could well be discarded for electricity, which is absolutely safe when properly installed, as well as being more convenient and better in other respects.

4. In the shop, the glue pot, solder pot, brazing iron, etc., can be heated advantageously by electricity, and one of the most gratifying consequences of our experiments has been the decision to put such an equipment in our college shops.

5. The test of the electrical flatirons showed them to be more economical than the old form, when the saving of labor is taken into account. Not only is there a saving in time, but the severity of labor is much lessened. Our experience is that a laundress who has used an electrical iron would be exceedingly unwilling to go back to the old form.

A small flatiron of two or three amperes attached to the ordinary lighting fixture in a dressing room is a great convenience; and with the electric teakettle and curling iron is destined to become essential in the modern home.

Concerning the question whether the use of electricity had proved satisfactory in its operations in the cooking tests described, the housekeeper in charge said: "The instruments were excellent in every respect. We were able to cook more rapidly, to keep the heat at just the right point, and could readily prevent over-cooking or under-cooking. While we were using electricity every dish was perfect. When I think of these advantages and of the cleanliness and convenience of the utensils, I sincerely hope that some of them at least may be retained in the house permanently."

The general results of the tests were of such a nature that the writer is warranted in the belief that if central station managers would more generally introduce exhibition equipments of these domestic utensils, a new call on their station capacity would develop, of which the larger proportion would be during the light load periods.

I wish to acknowledge my indebtedness to Mr. Rudolph F. Kelker, of Harrisburg, Pa., for his valuable aid in carrying out the work briefly described above.

THE BEHAVIOR OF ARGON IN X RAY TUBES.*

IN continuation of some experiments made by Prof. Callendar in the early part of 1896, the authors have studied the behavior of argon in X ray tubes of various types. The phenomena presented by a tube filled with carefully dried and purified argon are in many respects peculiar, as compared with those presented by other gases under similar conditions.

In the early experiments above mentioned it had been our custom to keep the X ray tube connected with the pump, which was used as a reservoir of dry air during long exposures. The gas, which was absorbed by the working of the tube at a high vacuum and a long equivalent spark gap, was restored from time to time, as the vacuum became too high, by letting a little air in from the pump by means of a convenient tap. In this manner it was possible to operate the tube at a very high rate of efficiency for two hours or more at a time. These long exposures were required for some experiments on the velocity of the X rays, which have been described in a communication to the Canadian Royal Society, May, 1896.

It was noticed on several occasions, after one of these long exposures, that there was considerable blackening and sputtering of the electrodes, and also that the pressure of the air in the tube had increased considerably above the degree of vacuum required for the production of X rays when the tube was first exhausted. After allowing the tube to rest for a few hours, although there was very little increase in the pressure, it was also observed that no cathode rays were produced until the discharge had been passed for some time. It appeared probable that some of these effects, which are recorded in the paper above mentioned, were due to the accumulation of argon in the tube. The spectral lines of that gas were on some occasions faintly discernible in parts of the tube, but no systematic spectroscopic observations were taken.

In making further investigations on the behavior of argon, we hoped to find that, owing to its natural inertness, the vacuum would be of a very permanent type as compared with other gases. We also hoped that its monatomic character would afford features of interest.

For the preparation and purification of the argon used in these experiments, the Cavendish spark method was adopted, as described by Rayleigh and Ramsay. For this purpose a special transformer was constructed, the primary and secondary of which were wound on different parts of the core. The primary was connected to the 100 volt lighting circuit. The secondary gave 10,000 volts on open circuit, available for starting the arc, but the voltage on the arc when running was only 2,000. The secondary could be short circuited, owing to the arrangement of the winding, without materially increasing the current or running any risk of burning up the coil. The apparatus could thus be left running safely by itself day and night without wasting any power on resistances. After concentrating the argon to about 60 or 70 per cent. in the flask it was further purified in a test tube apparatus, constructed so as to contain the minimum of liquid. The excess of oxygen was sparked off with hydrogen and the residue removed by absorption with alkaline pyrogallate. The argon thus purified was kept in a bulb containing P_2O_5.

In the first set of trials of this argon in X ray tubes, a Fleuss mechanical pump was used, which permitted very rapid exhaustion of the tubes, but had no arrangement for measuring the high vacua. The vacuum was estimated in these cases by the appearance of the tube and the width of the dark space.

The first tube tried had two aluminum electrodes, and had been lying open to the air for some time previously. It was exhausted and washed out two or three times with dry argon, and then sealed off at a good X ray vacuum. Each operation occupied only two or three minutes, and the vacuum has since that date deteriorated slightly, probably owing to insufficient removal of residual gas from the electrodes, but it still gives sufficient light to see the bones of the hand. The tube during exhaustion presented exactly the same appearances, except in color and spectrum, as if it had been filled with air.

The second tube had been worked up to a sparkless vacuum some weeks previously and had been frequently renovated by heating. It had an aluminum cathode and a platinum anode. It was connected to the pump and exhausted as soon as possible after opening. It was then filled with dry argon up to a pressure of one-fifth millimeter and exhausted to an X ray vacuum five times in succession. The glow on the cathode inside the dark space showed the F line of hydrogen and also the C line more faintly. These lines probably indicated the elimination of hydrogen from the electrodes, especially the cathode, as they became fainter with each repetition of the process of washing out.

At the sixth filling of the tube the pump was worked for ten strokes only. The cathode then began to sputter and blacken the tube and the argon was apparently absorbed, as the discharge refused to pass in three minutes. Fresh argon was again admitted, the coil was left running, but the pump was not worked at all. The spectroscope this time showed only blue argon without any trace of hydrogen. The concave aluminum cathode sputtered violently and partly melted down. In less than two minutes the discharge refused to pass through the tube, which was then sealed off.

The coil used in these experiments was a very small one, which gave a two inch spark with difficulty when running on a large eight volt battery.

The next tube upon which we experimented was a double focus tube, containing two aluminum cathodes and a platinum anticathode. This was washed out with argon and exhausted eight times with the two inch spark coil running all the time. The direction of the discharge was frequently reversed, but no trace of absorption could be observed. The argon lines always disappeared and the hydrogen lines, especially F, became faintly visible inside the cathode as the tube approached an X ray vacuum. The tube at each exhaustion gave fairly bright X rays and showed no blackening or sputtering. The hydrogen lines showed more brightly close to the cathode than in the body of the tube, where the argon lines were most conspicuous. The hydrogen appeared, in fact, to be coming out of the metal. The glass walls of the tube were in a very dry state, as it had been previously heated and exhausted.

Finding that we could not get rid of the residual hydrogen with the coil, we had resort to the alternating current, which we had previously found very effective in tubes with double electrodes. It appears that the elimination of hydrogen takes place chiefly, if not entirely, at the cathode. With the first application of the alternating current, the hydrogen lines showed extremely bright. The tube was then exhausted. In fifty strokes the discharge refused to pass. On refilling with argon to a pressure of one-tenth of a millimeter, the blue glow inside the dark space showed only argon and no hydrogen. The pump on this occasion was not worked at all, but the gas apparently was absorbed, and the discharge refused to pass in about three minutes. There was some sputtering of the electrodes and blackening of the tube, but the aluminum, though blistered, was not melted. The experiment was repeated twice with the same results. On reconnecting the tube to the two inch spark coil, the same absorption was observable, but less rapid. The electrodes were larger and were less heated than in the case of the first tube.

We concluded from these and similar observations, of which the above may be taken as a sample: (1) That the hydrogen occluded in the cathode played the part of carrier of the discharge from the metal to the gas. (2) That if there were sufficient occluded hydrogen, there would be little or no sputtering of the aluminum. (3) That when no hydrogen was present, the discharge was conveyed from the cathode by particles of the metal itself, which were capable of exciting fluorescence of the glass and of generating X rays wherever they impinged, behaving in fact as cathode rays. (4) That in X ray tubes, as usually exhausted, without excessive precautions for the drying of the gases and the complete removal of residual hydrogen from the electrodes, the residual gas was in most cases hydrogen or water vapor.

In order to test the behavior of other gases as compared with argon, similar experiments in the same tubes were made with dry air, hydrogen, and with water vapor.

With dry oxygen and nitrogen, the absorption of the gas was very rapid at a pressure of one-tenth of a millimeter, if the electrodes were sufficiently heated. Although hydrogen was not observable and was presumably absent, blackening of the tubes was very slight, and a much greater power could be applied than in the case of argon, without melting the electrodes.

With water vapor under the same conditions an X ray vacuum could not be obtained (owing probably to the slowness of diffusion), unless the tube were considerably heated, either with a flame or by means of an excessive current. On allowing the tubes to cool under these circumstances, the vacuum improved very greatly, owing to the absorption by the surface of the glass, and the discharge often refused to pass. Under steady conditions of running at a low temperature, there was no clear evidence of absorption of the water vapor, in spite of the drying tube on the pump.

With carefully dried hydrogen, under the same conditions, the process of exhausting the tubes with the mechanical pump was extremely rapid as compared with the other gases, owing to the greater velocity of diffusion of the lighter gas. With the smaller tubes, ten or twenty strokes were sufficient to give brilliant X rays, starting in each case with a pressure of half a millimeter to a millimeter. There was no marked absorption at any stage of the vacuum, and no trace of sputtering of the electrodes. We expected to find some evidence of absorption by the electrodes or the platinum anticathode, but it is possible that these became saturated with gas very rapidly at an early stage, and ceased to absorb gas at an X ray vacuum. We concluded that hydrogen was the most suitable gas to use in X ray tubes, but it is possible that helium, being also a very light gas, might be equally good if its inert or monatomic character does not lead to the disintegration of the electrodes in the same manner as in the case of argon.

If the great resistance to the passage of the discharge from the cathode to the gas in the case of argon is dependent upon the monatomic nature of the gas, it might be expected that similar phenomena would be observed in the case of mercury. Some mercury vacuum tubes were therefore made in the form of inverted U tubes. The electrodes were liquid surfaces of mercury in each limb, to which connection was made by short pieces of platinum wire, which did not project above the surface of the mercury. These tubes were exhausted and boiled with an alternating discharge passing, until more than half the mercury had distilled over. They then presumably contained only mercury vapor. When cool, the two-inch spark discharge refused to pass at first, but if the tube were tilted for a moment, so as to expose the platinum wire, it appeared that sufficient gas was liberated to enable the discharge to pass without any difficulty. The tubes showed only the mercury spectrum. In the high resistance state, immediately after boiling, the cathode limb, with a larger spark coil, showed brilliant fluorescence and feeble X rays. We concluded from these experiments that a very small trace of another gas was sufficient enormously to reduce the resistance of a mercury vapor tube, and that if the vapor could be obtained quite pure, it would possibly not conduct at all.

To verify more accurately the conditions of vacuum at which these phenomena occurred, the whole apparatus was subsequently connected to an automatic Sprengel mercury pump to which a McLeod gage was attached. The pump and all its connections were carefully tested for leakage, and the drying tube was filled with fresh P_2O_5. We had found in previous experiments of a similar character, made two or three years previously, that sulphuric acid, however carefully prepared, gave off appreciable quantities of water vapor, which would have been quite sufficient to vitiate these results.

Using a large coil and a slow mercury break, to avoid overheating the tubes, we found that fairly efficient X rays were obtained in most of the tubes at an average vacuum of 0·006 millimeter, if the tubes were exhausted in the ordinary way without taking special pains to remove the hydrogen. The H lines always showed faintly in the cathode light before this vacuum was reached. After using an alternating discharge to heat the electrodes, and carefully washing out the hydrogen as far as possible with argon, we found that the pressure corresponding to an X ray vacuum gradually increased up to 0·030 millimeter. Before letting the argon into the tube it was allowed to remain ten or fifteen minutes in contact with the fresh P_2O_5. On omitting this precaution and admitting the argon direct from a bulb containing an old sample of P_2O_5, which was beginning to deliquesce on the surface, it was necessary to raise the vacuum to 0·015 millimeter before X rays were produced. On the other hand, the sudden addition of dry argon at this stage up to a pressure of 0·020 produced no change in the appearance of the tube. It is probable that we never succeeded entirely in eliminating the residual hydrogen, but we concluded from these and similar experiments that the presence of the argon by itself had little, if any, effect on the production of X rays, since the amount present in the tube could be varied within wide limits.

We next endeavored to ascertain at what degree of vacuum the apparent absorption of the argon previously observed could be produced. For this purpose we used two tubes of the double-focus pattern, and an alternating discharge. Taking the first tube slightly damp from the blowpipe, we exhausted it to one-fifth millimeter vacuum with the mechanical pump. The discharge was then turned on and adjusted to heat the tube and electrodes as much as possible with safety, and the pump was not further worked. Under these conditions the remaining water vapor was rapidly expelled and absorbed by the P_2O_5, the tube soon showed a brilliant hydrogen spectrum followed by green fluorescence, the anticathode became red hot, then cooled, and in fifteen minutes the discharge (20,000 volts) refused to pass. The tube was not appreciably blackened. On connecting to the direct current discharge, it gave brilliant X rays. This case is interesting as showing that a very good vacuum may be obtained in these cases by simple absorption.

Dry argon was then admitted into the tube up to a pressure of 0·100 millimeter. At this pressure, in tubes three inches in diameter, with the direct or alternating current, the tube was filled with blue light, and gave a spectrum which was verified to be that of blue argon, without any visible trace of hydrogen or nitrogen. After running the direct and alternating current through the tube for half an hour, the tube became very black, but there was no change in the pressure as measured by the gage. It should be remarked that in measuring these high vacua, the pump was usually stopped to allow time for the equalization of the pressure throughout the apparatus. The alternating current in the primary of the coil was only 2·5 amperes with argon, whereas 4 amperes had been used with air. The latter current, if used with argon, would have melted up the cathodes. Finding no absorption at this pressure, the pump was started to run very slowly, and the same alternating discharge was continued. The sputtering of the electrodes rapidly increased, and at a vacuum of about one-tenth of a millimeter the upper electrode suddenly melted off. Another tube was then tried but met with a similar fate at the same degree of vacuum. The failure was so sudden that it was difficult to control the current in time. If the argon is actually absorbed, it is clear that the phenomenon depends upon very special conditions of temperature and discharge. It is possible that the absorption is only apparent, and corresponds to a very sudden increase of resistance to the discharge at a particular degree of vacuum, such as occurs in an ordinary X ray tube when the boundary of the dark space reaches the anticathode. With greater care, it may be possible to decide this point, but an unfortunate accident to our water mains prevented further investigations at the time. It is clear, however, that the behavior of argon is peculiar, and it seems probable that most of the ordinary cathode ray phenomena are due to residual hydrogen.—Nature.

* By Prof. H. L. Callendar, F.R.S., and Mr. N. N. Evans, Lecturer in Chemistry, McGill University, Montreal. (Read before Section A of the British Association, at Toronto.)

CHEMICAL PROCESSES IN A GAS PLANT.*

IT is a remarkable fact from the standpoint of the chemist that chemistry occupied itself for many years but little with this important branch of the chemical industry, and even to-day only the largest gas plants in Germany employ a chemist. Yet the gas plant offers to the chemist a wide field of activity, beginning with the purchase of coal and reaching to the selection of burners for the street lamps. The manufacture of illuminating gas, as is well known, has not become any simpler during the last two decades. The purifying methods, it is true, have remained the same in principle, but the apparatus has grown more complicated. This is due to the desire to obtain the greatest results on small areas. In the selection of the apparatus of a new gas plant, the voice of the chemist should be heard, for he understands to judge its effect, while the engineer should naturally occupy himself with the mechanical side of it only. Thus it may happen that the engineer thinks an apparatus good, while the chemist declares it bad.

The work of the chemist in a gas plant may be divided into two parts, namely, in the control of the finished gas, and laboratory work for the purpose of the most profitable production and utilization of the principal product as well as the by-products. As regards the control of the gas, this extends, in the first place, to its illuminating power. In Hamburg a 17 candle gas has to be furnished, which is measured in an Argand burner with a Bunsen photometer. This is done in four photometer rooms at the gas works and two in the city, in order to supply the consumers with as uniform a gas as possible, for it is known that from good coal good and also bad gas can be produced, depending upon the temperature of the retort ovens. In small plants, with a few ovens, this is quickly noticed; but in large plants it is less noticeable, as with many ovens there are always a few which do not come up fully to requirements. In the Hamburg gas works small retorts are in use, the charges ranging from 300 to 500 pounds. All attempts to produce good illuminating gas in large chambers or ovens after the pattern of those used in the coke industry have failed.

The second point to be watched by the chemist is the sulphur contents of the gas furnished. It is known that the gas must be freed from the last trace of sulphureted hydrogen. Sulphur contents in another form, however, are unavoidable, namely, sulphocarbon and sulphurous organic substances. By their combustion in the flame sulphurous acid and, according to conditions, some sulphuric acid are produced. Formerly there was much complaint in Hamburg over the action of the products of combustion of the gas, which attacked metals, textiles, etc. This proved to be simply due to the use of highly sulphurous English coals without lime purification as practiced in England. Lately, since a chemist is employed, it is possible to reduce by the proper selection of coals the high sulphur contents considerably, and the London limit of 22 grains of sulphur to 100 cubic feet of gas is maintained. Concerning the formation of sulphocarbon, this, of course, takes place in the retort already. The sulphureted hydrogen escapes together with the raw gas from the incandescent coal, and forms sulphocarbon with the latter. Highly sulphurous coal yields much sulphureted hydrogen, and for this reason much sulphocarbon, yet compared with the sulphureted hydrogen the quantity of sulphocarbon formed is always very small. Of less importance than that of sulphur is the other customary determination of carbonic acid and ammonium. The former is a remnant from the old lime purification, while now gas is purified by means of iron oxide, and the carbonic acid is left in the gas. Rather high contents of it can hardly be avoided. The London standard for ammonia is 4 grains to 100 cubic feet, but in gas produced by good apparatus seldom more than a trace can be found. Only in works where the apparatus is overburdened it is possible to bring more ammonium into the gas. It is well to determine the heating power of the gas by the Junker calorimeter in order to render it in this respect as uniform as possible. The most careful gas inspection is without doubt practiced in London, where the gas is examined photometrically three times a day at 14 stations, by 23 chemists, who have to analyze it also on sulphur and ammonium.

DETERMINATION OF SULPHUR IN COAL.†

IN the method proposed by Fischer, 1 gramme of coal is placed in a combustion tube containing asbestos or pumice, and is consumed in a current of oxygen. The products of combustion are passed through a washing apparatus containing bromine dissolved in hydrochloric acid, whereby the sulphur dioxide is oxidized and can be estimated as sulphuric acid by precipitation with barium chloride and weighing. To shorten the operation, Fischer also proposed to oxidize the sulphur dioxide by means of hydrogen peroxide and then determine the resulting sulphuric acid volumetrically, by titration with an alkali. This method is considered by the author as lacking precision, five tests performed by him on one and the same coal having yielded appreciably different results. He therefore proposes to modify the method by dispensing with the asbestos (or pumice), which retains a notable quantity of the sulphuric acid—probably in the condition of sulphates—and is very difficult to wash. He also suppresses the hydrogen peroxide, since this substance can rarely be obtained in a pure state, and moreover, by reason of its rapid decomposition, is liable to leave small amounts of sulphur dioxide unoxidized. The coal to be tested is inserted in a combustion tube, the posterior extremity of which is provided with a platinum spiral, and the oxygen is introduced through two pipes, debouching one in front and the other in rear of the capsule containing the coal. The products of combustion are led into a washing apparatus containing a titrated solution of caustic alkali, with a little methyl orange to act as indicator. This solution arrests the carbon dioxide, the sulphur dioxide and the sulphuric acid. When the combustion is terminated the washings of the combustion tube and platinum spiral are united with the alkali solution, and a freshly prepared solution of sodium peroxide, carefully titrated by the aid of methyl orange, is added. The whole is then boiled, and when the whole of the hydrogen peroxide has been decomposed, the total residual alkalinity is determined by means of normal acid. This gives all the data necessary for the calculation of the sulphuric acid fixed, and consequently of the sulphur present in the coal. The results obtained are very accurate, a Donetz coal found by gravimetric analysis to contain 3·65 per cent. of sulphur, yielding by the above volumetric method 3·61, 3·72 and 3·67 per cent. in three separate tests.

* From an address by Dr. Leybold, before the general meeting of the German Chemical Society, at Hamburg.

† N. Lasgovoi, Bulletin de la Société Physico-chimique Russe, xxiv, p. 344.

MERCURY PUMPS.

MERCURY pumps are, as well known, of great utility in laboratories, but certain difficulties are often experienced in making them work well. It is, therefore, not superfluous to make known the latest improvements that have been introduced into these apparatus.

M. Henriet, in recently presenting a new mercury pump to the French Academy of Sciences, recalled some of the inconveniences of the ordinary apparatus, such as leakages due to the cocks, and which the most careful lubrication fails to prevent, loss of time due to maneuvering of the cocks, and chances of breakages in consequence of ram strokes. The new pump does away with all such inconveniences, columns of mercury being substituted for cocks in its construction. No. 1 of Fig. 1 gives a general view of the apparatus, and Nos. 2 and 3 show the details.

To the lower part of the bulb, B, there is soldered a vertical tube, E, which descends and terminates at f. From the upper part of this same bulb there starts a capillary tube, G, which, curving around it, enters a mercury reservoir, M, situated beneath.

When the mercury descends from B, the air, coming from the orifice, f, enters it and produces a bubbling of the metal that ceases as soon as the limit of the vacuum is attained. When the mercury reascends into the bulb, B, the orifice, a, closes and the air is driven into the reservoir, M. It is the tubes, G and E, then, that replace the cocks.

The tube, E, presents at its upper part a bulb, F, de-

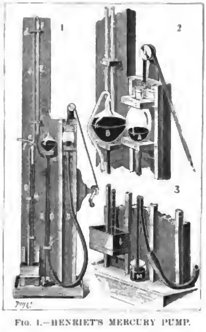


FIG. 1.—HENRIET'S MERCURY PUMP.

signed to prevent projections of the mercury, which can never enter the apparatus in which a vacuum is forming, since the tube, J, is bent at the base at e, so that the mercury falls into the barometric tube, H.

This tube, H, is designed to measure the pressure in the apparatus. It is beveled off at the lower part so as to permit of the introduction of gas into the pump without any projection of the mercury taking place. From the bulb situated at the top of H starts a tube formed of two equal parts—one of glass and the other of rubber. The rubber one permits of forming a partial vacuum by means of a shower bellows. The operation finished, a movable reservoir, I, receives the tubes, O and H, both of which dip into the mercury. The rubber tube offers no opportunity for leakage, since, when a vacuum exists in the pump, it is completely filled with mercury.

A rod fixed to the base, and not represented in the figure, permits of holding a test glass in the reservoir, M. It will be seen that every detail has been carefully looked after in this pump, and that it is possible, in fact, to prevent all those leakages that are so apt to occur in the ordinary apparatus of the kind.

M. Carlos Alban has recently devised a pneumobarometric pump that permits of quickly obtaining a satisfactory vacuum within a given space.

This apparatus, which is represented in Fig. 2, consists of a bottle, E, with three tubulures (No. 1), and of a barometric tube, T, terminating at the top in a bulb, A, the details of which may be seen in No. 2. This bulb is provided with two cocks, R and S, and a pressure gage, N. The apparatus as a whole is fixed to a board that carries in the center, movable around a horizontal axis, a pivot support which may be placed upon the edge of a table. It is therefore possible for the apparatus to assume both a horizontal and vertical position.

In order to form a vacuum, dry and boiled mercury is introduced into the bottle, E, in sufficient quantity to allow the bulb and barometric tube, when the apparatus is placed horizontally, to become filled, and enough mercury to remain to cover the lower aperture of the tube, T.

A vertical position is first given to the apparatus, in order to cause the mercury to descend, and after this it is gently brought to a horizontal one. The tube and then the bulb become filled with air, which escapes through the cock, S. The latter is then immediately closed. The apparatus is next placed in a vertical position again, the bulb remains empty, and upon opening the cock, R, it is possible to read upon the pressure gage the degree of vacuum obtained.

The cock, R, is afterward closed and the same operation is repeated until a vacuum of 1 or 2 mm. is formed. A bottle, O, placed at the upper extremity of the tube, is filled with phosphoric acid in order to absorb the aqueous vapor. An equilibrium is soon established in the two branches of the pressure gage, and we then have a barometer that may be utilized.

It is easy with this apparatus to repeat different vacuum experiments. The upper extremity of the tube, T, is connected by rubber with the apparatus in which the air is to be rarefied. Upon the cock, R, being opened, the air is sucked in and then introduced into the bulb, A. The cock, R, is then closed, the apparatus is placed in a horizontal position, and the air is driven to the exterior through the cock, S.

The apparatus, which is 5 ft. in height and 3 in. in width, is very easily manœuvered. With it, it takes but a very short time to perform various experiments, such as forming a vacuum in a Geissler tube, causing a jet of water to play in a vacuum, etc.—La Nature.

THE LOWER CONGO AND ITS PEOPLE.

FROM Banana to Boma the country is flat, and in the rainy season very swampy, the banks are thickly

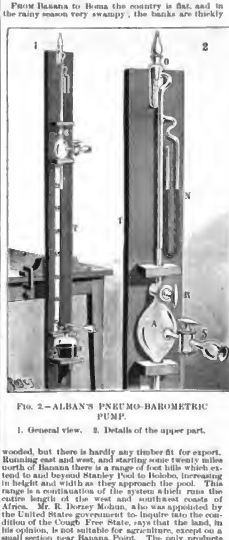


FIG. 2.—ALBAN'S PNEUMO-BAROMETRIC PUMP.

1. General view. 2. Details of the upper part.

wooded, but there is hardly any timber fit for export. Running east and west, and starting some twenty miles north of Banana there is a range of foot hills which extend to and beyond Stanley Pool to Bolobo, increasing in height and width as they approach the pool. This range is a continuation of the system which runs the entire length of the west and southeast coasts of Africa. Mr. R. Dorsey Mohun, who was appointed by the United States government to inquire into the condition of the Congo Free State, says that the land, in his opinion, is not suitable for agriculture, except on a small section near Banana Point. The only products of the soil shipped to Europe are palm kernels, palm oil and peanuts; and these are the only articles which are traded for by factories in the Lower Congo Valley. A few vegetables are grown in the gardens attached to each factory, but the soil has to be worked over and over again and watered two or three times a day in order to make them grow. No domestic animals exist among the natives, except a few goats and sheep, which command high prices. All the beeves, which are consumed by the railroad company's employes, are brought from Benguela and Mossamedes (on the southwest coast in Portuguese territory) by the Compagnie du Produit du Congo, which has established a large cattle ranche on the island of Mateba, below Boma. There are about 3,000 head there, and this herd is increasing. The tsetse fly does not exist, and the land is such that it could, no doubt, be made to yield profitably without an enormous sum being expended for irrigation. It is possible that on the hills to the north of Banana coffee might be grown advantageously, and cocoa on the lowlands; but the experiment has not yet been tried. The articles used for trade with the natives are red bandana handkerchiefs, gin, cloth, beads, machetes, old silk hats, colored parasols, cheap knives, flintlock muskets, powder, brass rods, crockeryware, tinware, old uniform coats, rum and watches. All these articles are speci-

ally made for the trade, and the standard of value is a piece of handkerchief 24 feet long and 3 feet broad, and valued at about 2s. 6d. When the trader buys produce he gives out cards to the natives which are good each for a piece of handkerchief, and when the caravan has been bought out the natives come to the store and hand in their cards, where they can select what they want to the value of the cards held. As a rule they will not touch money, regarding it as useless; and this, of course, is a great advantage to the trader, who makes large profits in exchange for handkerchiefs, which probably cost him, landed on the Congo, duty paid, about ten pence each. The quantity of gin which comes into the Congo is enormous, but none of this ever reaches the interior of the state, as its importation has been prohibited. Very little ivory is bought in the Lower Congo, and this comes from a distance of not more than 100 miles north, south or east of Boma and Matadi. The large quantities of ivory which are being shipped from the Lower Congo come entirely from the Upper Congo. These shipments are increasing year by year, and Mr. Mohun gives it as his opinion that there is ivory enough in Central Africa to last at least another century. The natives of the Lower Congo belong to the Fiote tribe, but there is absolutely no king or chief among them. There are some so-called kings; but they have no authority whatever and are only kings because they call themselves so, on account of having a few more rods, bales of cloth or boxes of gin than their neighbors. Each village is independent of the other and it has its own head man, but no one recognizes the right of any one as their supreme ruler. Fetichism is largely practiced, and there is much quiet poisoning going on in the different villages by fetich doctors, but the hanging of several of these poisoners by the state has had a most salutary effect upon the remainder. They practice no religion whatever; they worship no idols, no fire, sun, or moon, or stars. If they wish to accomplish something, they propitiate a wooden fetich by hanging beads and gin bottles about its neck and murmuring some jargon to it. If something is stolen from them, they drive a nail into the fetich, perfectly convinced that in this manner they will succeed in killing the thief. Near Boma there is a native school of medicine, and the people who attend it for study are called "Inkimbas." During their term of study they must keep themselves whitewashed or painted white from head to foot. The natives are not particularly savage or vicious toward the white men. Only once in a while has the state found it necessary to send expeditions to enforce the laws. They have no arms of their own manufacture, and for hunting and war purposes use the trade flintlock musket. When a native dies and is buried, if he is a rich man, his body is wrapped in hundreds of yards of cloth, and many pounds of gunpowder are fired over his grave, which has been covered on the top with empty gin bottles, demijohns, basins and pitchers; at the head a large red, blue and white umbrella is stuck in the ground and hoisted. At night his friends and family indulge in a dance and drunken orgie. Their hair is usually dressed in some fantastic fashion; on their legs and arms they usually wear large brass rings, and around their necks a necklace of beads or tin tags from packages of tobacco. Their only clothing consists of a breech clout, or piece of cloth tied round their loins; no head covering whatever. Their food consists principally of palm nuts, palm kernels, manioc and bananas; also rats, chickens and locusts. They are not a particularly strong or healthy people, their only strength lying in their legs; and it is very rare to meet one who has reached the age of fifty years, although many look a hundred years old. A great number die of pulmonary complaints.—Journal of the Society of Arts.

STATURE OF MEN OF GENIUS.

HAVELOCK ELLIS has been tabulating the measurements of height of 290 men of genius of all lands and ages. His idea is to find out whether the facts bear out the theory often stoutly urged that great men are apt to be short men. His conclusion is that they are apt to be either above or below the medium height. In the lists that he has compiled (Nineteenth Century, July), 113 of the men included fall into the list of tall men, 110 into the list of short men, and but 57 into the list of men of medium height. This medium height he places at from 5 feet 4 inches to 5 feet 9 inches. He does not claim accurate knowledge of the height of more than a small proportion of those whose names are included in the lists, classifying many by the mere description of tall or short as furnished by their contemporaries, precise figures not being obtainable. The results tally, however, with those derived from other sources, and furnish, Mr. Ellis thinks, a fairly safe basis for general conclusions. Among some of these conclusions, as drawn by him, we quote the following:

"It is clear that the belief in the small size of great men was not absolutely groundless. There is an abnormally large proportion of small 'great men.' It is mediocrity alone that genius seems to abhor. While among the ordinary population the vast majority of 68 per cent. was of middle height, among men of genius, so far as the present investigation goes, they are only 23 per cent., the tall being 41 per cent., instead of 16, and the short 37, instead of 16. . . .

"The final result is, therefore, not that persons of extraordinary mental ability tend either to be taller or shorter than the average population, but rather that they tend to exhibit an unusual tendency to variation. Even in physical structure, men of genius present a characteristic which on other grounds we may take to be fundamental in them; they are manifestations of the variational tendency, of a physical and psychic variational diathesis. In a slight and elusive shape, a shape so elusive that it is rarely hereditary, the man of genius represents the same kind of phenomenon which, in organic nature generally, appears to have slowly built up the animated world we know. Just as the visible world is the outcome of the accumulated gross variations of plants and animals, so the world of tradition and culture is the outcome of the accumulated delicate variations of men of genius. The product is different, but it has been obtained by the same method.

"It would be interesting if we could trace in a more detailed and precise manner the factor of physical stature in the constitution of the genius variation, and ascertain its precise significance. This is still difficult. One or two points may be noted.

"It must be remembered that genius, however it may be defined, is certainly only an excessive development of characteristics which may be traced in much more rudimentary forms. It is thus not impossible to throw light on the subject of genius by investigating the peculiarities of physical stature generally, and the common intellectual accompaniments of underdevelopment and overdevelopment. The conclusion we have reached, that both tall and short individuals tend to predominate unduly among persons of genius, is confirmed and to some extent explained by observation of the general population. The observations so far made, indeed, are few, but so far as they go perfectly definite. Thus Mr. Bohannon—who, under the inspiration of Prof. Stanley Hall, has collected data concerning over one thousand abnormal children in the United States, dividing them into various groups according to the predominant abnormal character—finds that both tall children and short children are intellectually superior to children of medium height. The tall (except in cases of very excessive tallness, which may be regarded as pathological) showed their superiority both in general health and mental ability; at the same time they were notable for their sensitiveness, good nature, even temper and popularity with others. The small were less often healthy, and consequently were apt to be delicate, ugly or vicious; but when fairly healthy they tended to show very great activity both of body and mind. . . .

"It would still remain to show the causes of this tendency; for it is scarcely possible to hold that the health and ability of the tall is due (as has apparently been suggested) to forced association with their elders in youth, and quite absurd to hold that the activity and mental quickness of the small is due to the arrested development caused by forced association with their juniors. In both cases it seems probable that the primary cause is a greater vital activity, however we may ultimately have to define 'vital activity.' Among the tall such intensity of vital action has shown itself in unimpeded freedom; in the short it is impeded and forced into new channels by pathological or other causes. The latter case is perhaps the more interesting and complicated. An anthropometric examination of short men of genius would throw much light on this question. There are certainly at least two types of short men of genius: the slight, frail, but fairly symmetrical type (approaching what is call the true dwarf), and the type of the stunted giant (a type also to be found among dwarfs proper). The former are fairly symmetrical, but fragile; generally with little physical vigor or health, all their energy being concentrated in the brain. Kant was of this type. The stunted giants are usually more vigorous, but lacking in symmetry. Far from being delicately diminutive persons, they suggest tall persons who have been cut short below; in such the brain and viscera seem to flourish at the expense of the limbs, and while abnormal, they often have the good fortune to be robust both in mind and body. Lord Chesterfield was a man of this type, short for his size, thickset, 'with a head big enough for a Polyphemus.' Hartley Coleridge carried the same type to the verge of caricature, possessing a large head, a sturdy and ample form, with ridiculously small arms and legs, so that he was said to be 'indescribably elfish and grotesque.' Dryden—'Poet Squab'—was again of this type, as was William Godwin; in Keats the abnormally short legs coexisted with a small head. The typical stunted giant has a large head; and such stunting of the body has, indeed, a special tendency to produce large heads, and therefore doubtless those large brains which are usually associated with extraordinary intellectual power. It is a curious fact—as a distinguished anatomist, the late Sir George Humphrey, remarked many years ago—that when from any cause the growth of the rest of the body is stunted, the head not only remains disproportionately large, but often becomes actually larger than in ordinary persons. 'Thus short persons and persons with imperfectly developed lower extremities are not uncommonly remarkable for the size of their heads, as though the expenditure of growing force being too great in one direction, other parts are ill cared for.' It may be added that the commonest type of dwarf possesses a proportionately large head and short legs.

"It would doubtless be an attractive task to attempt to trace the causes which lead genius to be associated at once with both abnormal extremes of stature. It must probably be found at an early period of embryonic development, when, as we know from the researches of Dareste and others, the causes of dwarfism may also be found, sometimes in arrest of growth resulting from precocious development. Here, however, it is enough to have ascertained the facts in a roughly approximate fashion. It need only be pointed out, in conclusion, that the result we have reached, although apparently new, is such a result as should have been expected. Geoffroy Saint-Hilaire long since, and Ranke more recently, have pointed out that both giants and dwarfs—the abnormally tall and the abnormally short—are usually abnormal in other respects also. From the biological point of view we know nothing of 'genius,' what is so termed being simply an abnormal aptitude of brain function; so that among those variations and abnormalities which, as is already generally agreed, we find with unusual frequency among the very tall and the very short, extraordinary mental aptitude ought sometimes to occur."

ECHINOCYSTIS LOBATA—HARDY ANNUAL.

ECHINOCYSTIS LOBATA.

THIS is an annual trailing plant, which will not find favor with those who love brightly colored flowers, but the elegance of its habit will commend it to others. It is a cucurbit native to the Northeastern States of America. The plant is nearly glabrous, with slender, angular stems, palmately lobed leaves, branching tendrils, and male flowers in branching panicles, the female flowers solitary, shortly stalked, from the same axil as the male flowers, and ripening into an ovoid greenish berry studded with small prickles. We are indebted to the Gardeners' Chronicle for the cut and copy.

RENEWING OLD TREES.

OLD trees are among the most cherished treasures of rural and suburban homes. They are the most costly, too, as every finished product is costly into which has entered those transforming and creative processes which only long reaches of time can furnish. An old house may fall down or be destroyed by fire, and while we mourn the loss of the visible sign of old associations, a better and more beautiful structure can be made to take its place. But when an old tree that has been the

guardian of the home for generations, and stood there before the home was founded, surrenders to the blast, the loss is beyond repair, for a long time, at least. As there is no immediate remedy possible, the need of precaution becomes all the greater. When one of these old sentinels begins to show signs of disease and decay and year by year grows more attenuated in its branches and weaker in leaf growth and power, we watch it as we watch a friend attacked by a slow but incurable malady. But remedies are now being discovered for almost every ill of the body, and successful tree surgery is or may be as common as the higher form of that science. A recent number of Garden and Forest discusses the rejuvenescence of old trees, and gives practical directions for effecting it. Directly to the point are two illustrations of the same tree, a venerable oak in the Arnold arboretum. The first is of a tree with far reaching branches, but marked by infallible signs of decrepitude, the leafage scanty and the general prospect of life discouraging.

The second illustration shows the same tree twelve years later, shorter of limb, it is true, but displaying vigor in every leaf and fiber, and exhibiting every characteristic of youth and strength and hopeful promise of longevity. No miracle, not even one of Nature's, has been performed. The result is simply one of skillful tree surgery, of intelligent pruning according to the De Car's system, which, instead of sending the tree blood long distances through collapsed and withered arteries, contracts the area and applies the nourishing forces in such a way that they can be assimilated and made to promote the growth of all the members. The process is one which almost any intelligent farmer or tree owner should be able to apply. "Vigor can be restored to a tree in this condition by shortening all its branches by one-third or one-half their entire length. The only care needed in this operation is to cut back each main branch to a healthy lateral branch, which will serve to attract and elaborate by means of its leaves a sufficient flow of sap to insure the growth of the branch." These directions must be carefully observed to prevent further decay, and care must also be taken to leave the lowest limbs the longest, so that the greatest possible leaf surface shall be exposed to the light. So if some old tree, near roadside or dwelling, that has been the landmark of a century, shows alarming symptoms, the owner should not despair before he has treated it according to the general plan here laid down.—Boston Transcript.

TOBACCO IN GERMANY.

THE consumption of cigars is steadily increasing in Germany, whereas the use of the old clay or porcelain pipes is steadily decreasing. In the cigar manufactories of Baden alone 1,000 to 1,200 more workmen were engaged last year, and it is said at the same time that the goods stored in 1895 have also been disposed of; the demand at times was greater than the production. Through the increase of cigar factories, there is a growing stock of raw tobacco for pipes. But while the cigar is driving out the pipe of the German middle classes, the laborer and the peasant, on the other hand an enemy is arising for the cigar in the cigarette and short pipe, the use of which has been imported into Germany from England.

The consul-general at Frankfort says that the German manufacturers of cigarettes look upon the constantly increasing use of foreign cigarettes in Germany with much uneasiness. The import, which in 1895 was only 44,900 kilogrammes (98,780 lb.), advanced to 161,800 kilogrammes (355,960 lb.) in 1895, and 171,700 kilogrammes (377,740 lb.) in the first eleven months of 1896. It surpasses the value of the German export of cigarettes already six times, and is at least half as large as the value of the cigarette manufacture in all Germany. France is sending large quantities of cigarettes each year, and the imports from Turkey, Greece, and Herzegovina are also increasing. It is stated that the importation of English smoking tobacco might be increased, and it is already slowly but steadily gaining ground. At Frankfort a great deal of English tobacco is smoked, especially by the upper classes.

It is Consul Oppenheimer's opinion that English tobacco and pipe manufacturers might with advantage open business connections in many places in Germany. The wooden pipes which of late have almost entirely ousted clay and porcelain pipes are indeed manufactured a great deal in Germany, but they are finished in England, especially the better qualities (silver mounted), and these find a ready market.

Considerable attention has lately been given in Germany to innovations in the culture of tobacco. The tobacco plant has been known in Europe for three centuries, and during the same period its culture has been an annual one. The seed is sown in hot beds, brought to germination there, and when the young plants have grown somewhat, they are transplanted into open soil in order to be harvested when the valuable leaves have developed. This culture is based upon the idea that the tobacco is an annual plant and cannot outlive the winter, so that it must be sown annually, and be planted afresh every year. Now it is said that tobacco planters and botanists have been mistaken.

Wilhelm Darocsi, of Budapest, the editor of a Hungarian tobacco journal, has proved that tobacco is a perennial plant, which may be kept in full vigor for years, and that it then has fresh leaves every year. Should these leaves in the second year and later on prove of use for smoking material, this discovery will bring about the possibility of saving the tedious and expensive method of growing seedlings every second year or oftener, and doing away with their planting in the open fields, and thereby of reducing the cost of production of tobacco very considerably. Whether this will be applicable also to the German climate cannot yet be asserted without trial.

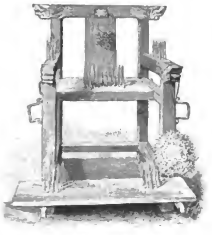
Two German tobacco manufacturers have also kept tobacco over winter as decorative plants, and one of them is even in possession of a plant aged seven years. Both are of opinion that these perennial plants only [illegible] diminutive leaves, so that the value of [illegible] over winter is but trifling, regarding them [illegible] point of view of leaf tobacco. [illegible] is of a different opinion in this respect. [illegible] to his views these small leaves are only a [illegible] of the unfavorable climate, perhaps the [illegible] also with the kind of plant which had been [illegible] to stand over the winter; at all events he says that he obtained good useful leaves even in the second year's crop in Hungary.

Though in this respect the importance of the discovery may be doubtful for the culture of tobacco, the observers are so far unanimous on one important point, viz., as to the possibility of increasing the tobacco by seedlings from perennial plants. This observation is of the greatest importance; if it is possible by cutting the tobacco plant after the harvest to shield the roots against frost by covering them up, they will, at the beginning of spring, germinate again and furnish shoots which can be planted out. In this way it would be possible to shift the tobacco harvest in Germany into a more favorable season of the year. This may become of importance to the culture of tobacco in such a way that tobacco gathered and dried under more favorable temperature and conditions of humidity would probably be much better in quality than hitherto.—Journal of the Society of Arts.

THE GUIMET MUSEUM.

THE Guimet Museum, which was founded at Lyons eighteen years ago, and afterward ceded to the government, was, in 1888, transferred to Paris and installed in the vicinity of the Trocadero. This public museum, now classed among the national institutions, serves for diffusing information as to the civilizations of the East and for facilitating religious, artistic and historic studies by means of the images and sacred books and of the objects of worship and art that compose its magnificent collection.

FUNERAL MASKS FOUND IN THE EXCAVATIONS AT ANTINOE.



CHINESE ARM CHAIR PROVIDED WITH SPIKES.

We wish at present merely to call attention to a few of the novelties with which its already large collection has recently been enriched.

One entire hall is devoted to documents concerning Egypto-Roman worship. In the excavations made at Antinoë, a city founded in Egypt by Emperor Hadrian, and under the ruins of a granite temple that had been pointed out to M. Guimet, M. A. Gayet found half of a statue of a Roman Isis. Exploring, in addition, the ground comprised between the city and the Arabic chain, the learned Egyptologist discovered the site of four cemeteries of different ages. Although the Egyptian, Byzantine and Coptic necropolises yielded up to him only objects of which museums already have specimens, the Roman necropolis, on the contrary, held a surprise in store for him. An entire humanity, an entire civilization, arose therefrom in the form of human remains, now draped in the Roman style and now clad in Asiatic robes. The fabric of these garments, which were Oriental silks woven by Syrians who were experts in combining shades, flowers and symbolical animals, are marvels of color and design. There were also fine women's leather shoes—real Cinderella slippers, stamped in gold with ornamental dies. The majority of the bodies had upon the face a plaster mask (see accompanying figure), provided with enamel eyes and constituting a true portrait. Among the finds we may mention a small convex mirror, not of metal, but of glass backed with mercury. For the history of science and industry, this is a very unexpected and important relic.

In hall No. 7, devoted to the religion of the Parsees or Guebres (adorers of fire and followers of Zoroaster), a very interesting number is a reconstruction of a religious ceremony. A large glass case incloses a group of four figures of natural size—two Mazdean priests and a young man and young woman. The officiating priest, who is of the Rasmic sect, is seated upon the floor with his legs crossed, and is placed in such a position as never to have his face turned toward the north. He wears the "pagri," a sort of high cap, which, like the rest of his costume, is white. His mouth is concealed behind a "padam," conformably to the doctrine of Zoroaster, which regards the saliva, breath, etc., as impure. The other priest, who has a long beard and stands to the left, belongs to the Kadimie sect. He is clad in an ample "jama," girded with the "pichori," and wears upon his head a sort of turban called a "phenta." The young man wears a tunic called a "dougly," and a pair of red silk trousers and a black "pagri." The costume of the maiden consists of a pale rose colored tunic called a "sari," a girdle ("kusti"), a head band ("mathabana") and a sacred chemise ("sudra"), an essential part of the Zoroasterian livery.

A PARSEE RELIGIOUS CEREMONY.

The metallic utensils, arranged upon the low table before which the priest sits to celebrate the office of the Yacna (offerings to the sacred fire), are thirteen in number: The "mahrou," serving as a support for the "barsom," a bundle of date twigs, the "kavan," or mortar, in which the "haoma" is brayed; saucers, or "thaste," one of which contains a ring surrounded by a hair of the sacred bull; and vessels for the sacrificial fire, which must not be confounded with the sacred fire, which is always shut up, out of sight, at the back of the sanctuary.

The Guimet Museum alone owns a complete collection of such utensils, which, like the costumes of the figures just mentioned, are absolutely authentic.

Among the curiosities in one of the halls may be seen an arm chair from Amoy—a terrible instrument of voluntary torture, of which the seat, back, arms and foot rest are studded with sharp points. It ap-

pears that there are fanatics who allow themselves to be carried in this in processions, and, in addition, inflict upon their flesh numerous blows with a ball bristling with iron spikes.—L'Illustration.

THE UNIFICATION OF TIME.*

TIME reckoning, as at present conducted, presents curious anomalies. The civil day begins at midnight and ends at the following midnight. The nautical day begins at preceding noon and concludes at noon of civil day. The astronomical day begins at noon and ends at the following noon. It is therefore apparent that any given date extends over, or into, three different days. Many navigators, however, for many years past, have for convenience kept civil time at sea, redating their logbooks from midnight. A movement to reform time reckoning had its origin on the American continent, from the circumstance that the embarrassment of many independent reckonings had been most powerfully felt in the United States and Canada, those lands of magnificent distances, and that hold within themselves and between their bounding oceans so many degrees of longitude. It is stated in the last report of the Royal Society of Canada dealing with this subject that so late as 15 years ago there were between the Atlantic and Pacific no less than 70 different standards of time referred to in the working of the different railways quite unrelated to and independent of each other. It would necessarily result that as steam and electricity would open the continents of Asia, Australia, and Africa, not to mention the continent of Europe, the difficulties felt on this continent would be further extended.

The movement to effect a reform in the time reckoning of all nations took its origin in Canada in 1876, and therefore as to age it has attained its majority, but not yet its entire fruition. The Canadian Institute was probably the first scientific society in any part of the world to give the subject earnest consideration. At the meetings of this society held in February, 1879, the reckoning of time and the establishment of a prime meridian as a general time zero to be common to all nations was fully discussed. In May and July, 1879, and in May, 1880, the Governor General of Canada brought the views promulgated by the Canadian Institute to the notice of the imperial government, and through the imperial government the attention of foreign powers and scientific societies in all parts of Europe was directed to them. At a meeting of the American Society of Civil Engineers held in Montreal in 1881, Mr. Sandford Fleming (now Sir Sandford Fleming), a Canadian member thereof, led a discussion in formulating certain principles as to reckoning and unification of time.

An active interest in the subject was awakened among the members of this society, many of whom were intimately associated with the great railways of America. An important outcome was the general adoption, a few years afterward, of the system of standard time by which the confusing multiplicity of standards, previously in use, were abolished, and the reckoning by the meridian of Greenwich as the prime standard throughout the United States and Canada. In this consummation the American Meteorological Society heartily co-operated. The Canadian Institute and the last named society sent Mr. Fleming to Venice to attend the International Geographical Congress held in September, 1881; his special mission was to advocate the establishment of a first or prime meridian to be common to all nations as a time zero. The United States and Canadian delegates, among other things, suggested that an international conference should be specially convened to determine upon such a zero meridian, and proposed that such a conference should be held at Washington. The Congress of the United States thereafter, with a view to the principle of uniformity and simplicity of time, passed a resolution in the direction of obtaining an international agreement regarding time reckoning, and thus sought to minimize the difficulties arising from the confusion that then prevailed, and which still, to some extent, continues to prevail. The representatives of 25 nations, as well as the Canadian representative named above, met in Washington in 1884, at the invitation of the President of the United States, and after a conference extending over a month passed seven resolutions, the first five of which have been practically and generally accepted by the civilized world. The observations which follow have a special bearing upon the sixth resolution of that remarkable conference, which was carried unanimously, and is as follows: "That the conference expresses the hope that as soon as may be practicable the astronomical and nautical days will be arranged everywhere to begin at mean midnight."

It is also evident that as the nations which publish ephemerides prepare them four or five years in advance, and as it is important that any date upon which the new era shall commence be one easily remembered by astronomers and computators or navigators, a common understanding should not be delayed beyond the first year of the coming century or 1901.

The question of time reform remained in this position until the year 1893, when the Astronomical and Physical Society of Toronto, in co-operation with the Canadian Institute, appointed a joint committee, with Sandford Fleming as chairman, to suggest the best means of ascertaining the views of astronomers throughout the world. This committee accordingly, upon April 30, 1893, addressed by circular letter the following question to astronomers and other scientific men throughout the world:

"Is it desirable, for all interests concerned, that on and after January 1, 1901, the astronomical day should everywhere begin at mean midnight?"

The replies received were in number 171, of which 108 were favorable to the change and 63 unfavorable. Many of the former are strongly and earnestly in favor of the adoption of the civil day for astronomical purposes, while the writers of some of the latter seem to have been under a misapprehension. They object to the adoption of the civil day on the ground that its division into two series of 12 hours, designated A. M. and P. M., would be inconvenient for astronomers. It is obvious that this objection has no weight, as the 24 hour notation would remain associated with astronomical reckonings as at present; moreover, indications are not wanting that the astronomical practice of counting the hours in a single series from 1 to 24 will gradually win its way into general favor in civil life. The 24 hour notation has already been introduced into use over wide districts in Canada, in several European nations, and throughout the Indian empire; and there is a movement in Europe, in Australia, as well as in the United States of America, especially among railway men, to bring this mode of reckoning the hours into general use.

In classifying the replies from astronomers according to the countries from which they have been received, the votes for or against the change stand as follows:

In Favor of the Change.

Austria	Australia	Belgium
Canada	Colombia	England
France	Greece	Italy
Ireland	Jamaica	Madagascar
Mexico	Roumania	Russia
Scotland	Spain	United States

Unfavorable to the Change.

Germany	Holland
Norway	Portugal

Classifying these results according to the shipping of the different countries represented, we find that those favoring the change represent 85 per cent. of the tonnage of the world's marine. This fact has an important bearing upon the whole question when the convenience of the navigators, with whom the "Nautical Almanac" is a vade mecum, is considered.

This report was communicated to His Excellency the Governor-General, for transmission to the British government, by whom it was finally referred to the Admiralty. The Lords Commissioners of the Admiralty, under whose supervision the "Nautical Almanac" is published, expressed their willingness to sanction such alterations as may be necessary to effect the change at the beginning of the new century, provided other nations who publish astronomical ephemerides are prepared to take the same action. The British government thereupon instructed Her Majesty's representatives to ascertain the views of the foreign governments to which each was accredited, with regard to the proposed change. Of these nine powers, six have formally given their ascent to the proposed change.

The six nations formally assenting to the adoption of the recommendation of the Washington Conference on January 1, 1901, are Austria, Brazil, France, Great Britain, Mexico and Spain. Of the remaining three, Germany and Portugal have not, so far as is known, sent any reply. A brief communication has been received from the Secretary of State at Washington, simply stating that "the members of the United States Naval Observatory are adverse to the 'Canadian proposition,' as they term it, and, at the same time, he sends a copy of the adverse report, signed by these three members."

This is the only report from astronomers and observatories the world round which is of a negative character, and it is the more extraordinary as it also negatives the position taken by the United States from the inception of the movement to reform time reckoning. That country has been in the very forefront of the project; it has, in fact, borne its standard and spread its banner. Its government, its learned societies, its scientists, its practical men, its railway managers, its people, have been at the very cradle of time reform, have carefully watched its adolescence, have rejoiced at its coming vigor; but now in its twenty-first year the Washington Secretary of State has been advised to refuse its adoption. Verily, this child of the Washington conference, introduced into public notice in 1884, by five distinguished delegates as nominated by the United States government, and hailed with the acclaim of 25 nations and Canada, constituting that conference, has had that mark of paternal preference, the coat of many colors, torn from him, and he stands denuded, if not, indeed, wounded, in the house of his own friends.

So far these remarks have dealt with the efforts made by the Canadian societies for the unification of the astronomical and civil day, but the proposition of the Washington conference went further. It sought to bring also into harmony with these two a third discordant note, that of the nautical day. But thus far it has been, only historically but not effectively, a voice—vox sed preterea nihil. It is comparatively easy to obtain opinions of astronomers, as they are for the most part attached to observatories or their addresses are known; but navigators pursue their calling under such different circumstances, being either at sea or for a very short time in port, and then being much occupied with the active duties of their profession. It, however, by no means follows that shipmasters are indifferent to this subject, which so much concerns their business and convenience. In order to reach the opinions of British and foreign shipmasters on this subject, communication was opened by the Astronomical and Physical Society of Toronto, with Mr. W. Nelson Greenwood, F. Imp. Inst., of Lancaster, England, the compiler and publisher of certain kindonometric or tide tables issued at Manchester, England. The result was that Capt. Greenwood propounded the following questions to shipmasters:

1. Are you in favor of the Greenwich meridian being universally recognized as the prime or first meridian by all?

2. Are you in favor of the unification of time as reckoned from such prime meridian and extended to all nations irrespectively?

3. Are you in favor of the unification of time as applied to the civil, nautical and astronomical days; and is it desirable in the interests of all concerned that such days should commence at mean midnight?

4. Are you in favor of reckoning the days by the 24 hours' system, counting the hours for each civil, nautical and astronomical day from mean midnight throughout the 24 hours to midnight again? This will do away with the old A. M. and P. M., but will make mean noon the twelfth hour for all three systems of time reckoning alike.

As question 3 affects more directly the subject bearing of this paper, I confine myself to that.

The result was that, up to July 25, 1896, 409 shipmasters from steam vessels and sailing vessels, both British and foreign, were heard from, and of these 399 answered "Yes" and 10 answered "No" to above question 3. Of these, 363 were masters in active service, representing a total tonnage of 455,810.

There would, therefore, appear a very large amount of unanimity throughout the nations of the world for the proposed changes, but yet there was not absolute unanimity; and to the communication from the joint committee of the Canadian Institute and the Astronomical and Physical Society of Toronto forwarded through the office of His Excellency the Governor General to the Lords Commissioners of the Admiralty, a reply was received in December, 1896, that inasmuch as unanimity in the effort to make the desired change on the part of other nations that published ephemerides had not been obtained, their lordships had no intention of moving in the matter.

In many most important matters involving the welfare or convenience of mankind and in which consent is necessary, a minority—even a small minority—exercises a controlling power. This is one of these matters. But it has not been allowed to rest. The importance of the subject demanded further movement, and that movement in the straight line of a more widespread knowledge and of a continued and (if possible) a clearer presentation of the advantages of the proposed reform.

At the last meeting of the American Society of Civil Engineers, in June, 1897, a resolution was formed authorizing and requesting the board of directors of the society to take such steps as they may deem advisable to move the United States government to finally adopt the sixth resolution of the Washington Conference in 1884.

It is expected that the American Meteorological and other societies in the United States will take similar action. On June 25, 1897, the Royal Society of Canada, at its meeting in Halifax, Nova Scotia, passed the following resolution:

"That as there is a reasonable prospect of the United States accepting the recommendations set forth in the sixth resolution of the Washington Prime Meridian Conference of 1884, the council be authorized and requested to take such further means as may seem best calculated to secure unity of time reckoning at sea as on land; and with that view a special request be made to the British Association, when it meets in Toronto, to co-operate with the Royal Society and other Canadian societies in influencing Her Majesty's government to adopt the proposed change on the first day of the new century, and to make such alterations as may be necessary on the 'Nautical Almanac' as soon as practicable."

The question of the unification of time is not a new one. In fact, it offers an illustration, on the one hand, of the apothegm that "there is no new thing under the sun," and, on the other hand, furnishes an example of that philosophy which teaches that "the thoughts of men are widened with the process of the suns."

Hipparchus, "the father of astronomy," himself counted the hours from midnight to midnight. He found no difficulty in commencing an observation on one day before 12 at night, and ending it the next day after the same 12 at night. Some modern astronomers, it is said, find this is an insuperable obstacle. They might forget to note the change from one day to another. Ptolemy introduced many errors into science, which the world for many centuries believed were truth, and among his errors introduced the practice of taking noon as the moment from which the hours were to be counted. The present astronomical day is then a relic of the Ptolemaic system. The rest of this false philosophy has long ago disappeared. This part, the only part, still survives. It does not, however, survive because it is the fittest, but because it is not the fittest—upon the Lucus a non lucendo principle. And so it remained until in 1804 La Place sent to Le Bureau des Longitudes a letter in which he proposed to unify astronomical time with civil time by counting the hours from midnight, which proposal they adopted. Nevertheless, La Connaissance de Temps continued, and still continues, to appear in the Ptolemaic method of counting astronomical time. La Place, however, who possessed the instincts of a genuine reformer, in La Mécanique Celeste and in the calculation of his tables employed civil time; and in this was imitated by the other French constructors of tables until Le Verrier put on the old garments of a non-scientific conservatism, and started his day at high noon. After the Washington and Geneva conferences and with their discussions before him, M. Faye, the French astronomer, was reminded that the bureau had, under the influence of La Place, formerly calculated the lunar and planetary tables for Paris mean midnight, but no change was made.

The bureau was consulted in 1894 by the Minister of Public Instruction for France, and on October 19 in that year reported in favor "of the principle of the reform set forth in the sixth resolution of the Washington conference, and advocated by various societies in Canada and in the United States," and favored the adoption in practice, provided that the countries publishing the most important ephemerides took concerted action. The bureau, moreover, took a step further in a most important direction. It officially expressed to the Minister of Public Instruction the decided opinion that unification would not be complete until the civil day should be reckoned, as in Italy and in other countries mentioned, in one series of hours from 0 to 24, and so do away with the old notation of A. M. and P. M. This further reform has been already legalized by an act of the Province of Ontario, 58 Vic., Cap. 11, being "The Definition of Time Act, 1895," which provided that the time referred to in any act of legislature, by law, deed, or other legal instrument, be held to be standard time; and as regards that part of the province lying east of the meridian 87° west longitude, standard time shall be reckoned as five hours behind Greenwich time; and as regards that part of the province which lies west of the said meridian, standard time be reckoned as six hours behind Greenwich time.

And it was further enacted that the hours of the day and night in any locality be numbered in one series up to 24, according to the "24 hour notation" so called. So that in respect to time reform, the Province of Ontario has been doing all she can to stand in the foremost rank. This reform has the support of the highest authority.

Sir John Herschell writes: "Uniformity in nomenclature and modes of reckoning in all matters relating

* By John A. Paterson, M.A., President of the Astronomical and Physical Society of Toronto. Paper read before the British Association, Toronto meeting.

to time, place, weight, measure, etc., is of such vast and paramount importance in every relation of life as to outweigh every consideration of technical convenience and custom."

Mr. Christie, the English astronomer royal, among many other potent reasons in support of the change as affecting astronomy, points out that for spectroscopic and photographic observations of the sun, the day is reckoned from midnight, and the same reckoning would naturally be used by the observer for spectroscopic and photographic observations at night and also in determinations of the places of comets, stars, etc., which he may take in connection with his spectroscopic observations. It would seem passing strange to expect the same observer to change his system of reckoning mean solar time according to the class of observations he is making at the moment. Commodore Franklin, Superintendent of United States Naval Observatory, Washington, in December, 1884, just after the Washington conference, wrote a strong argument in support of the change, and remarked: "It seems to be eminently proper that the nation which called the conference should be among the first to adopt its recommendations."

These deponents are culled at random from a great cloud of witnesses and testify accordingly. For the sake of brevity, I do not call to the witness stand Cleveland Abbe, Burckhalter, Comstock, J. E. Gore Hadden, Garrett P. Serviss, Captain Abney, Lewis Swift, Trouvelot, Dr. Max Wolf, and a host of others. But what are the objections urged in opposition to the adoption of this reform? It is said that for a time confusion would prevail at sea. The evident answer to this is the testimony of navigators themselves, as has been above set forth by Captain W. N. Greenwood. These men who stand on the quarter deck and handle the sextant and the "Nautical Almanac" know whereof they speak, and they have not spoken in ambiguous voces, but loudly and definitely. Are we to hear and to give effect to their evidence, or are we to listen to others who live ashore and think they know better? To this there can be only one answer. The other objection to the change is that it would be inconvenient for astronomers and computers. No doubt the change from the Julian to the Gregorian calendar was an inconvenience, and if that objection had prevailed about the year 1582, and continued to prevail, we would have been now still groping along in the dark and devious ways that Cæsar projected. Whose convenience is to be consulted, that of the astronomer or that of the navigator? The astronomer and the computer are not pre-eminent, and their "Nautical Almanac" is not the end. All these are only means to the end, and that end, in so far as this subject matter reaches, is to facilitate the work of the navigator and to perfect the art of navigation. The navigator was not made for the astronomer, but the nautical astronomer for the navigator. There is confusion now, for in various official publications some portions are given in astronomical time and other portions in civil time; but let this reform be inaugurated, and straightway for the future the wrinkles and creases are smoothed out, and harmony reigns, and the sooner the better, so that the masses of incongruity may not further accumulate.

But it may be said that this reform cannot be made practicable in the year 1901, inasmuch as the ephemerides for that year are now published. That circumstance, however, in no respect affects the principle involved in the question. The wisdom of the reform being established, then the date of its inception is a mere matter of detail and may be left for some mutual agreement to be come to among governments interested. If we once get down to the base rock of the principle of uniformity, then it is a matter of certainty that its inauguration will follow very rapidly. At the same time there is a peculiar fitness in having the resolution of the Washington conference carried out literally, that is, on the first day of January, 1901, and that matter could no doubt be accomplished by publishing a supplement to any ephemerides already published for that year.

All reforms have to overcome a certain callousness of custom before they can be accommodated to the various convolutions and angularities of opinion and convenience. Much deliquescence of dogmatism must result before the current of reform shall run smoothly over the rocks of conservatism and mingle with the broad and ever broadening ocean of knowledge, and thus add a fresh sparkle to the face and form of rainbow-vestured truth.

Our feet almost touch the threshold of the twentieth century, our hands are almost on the latch that opens to us new history. Centralizing, harmonizing and unifying are strongly impressive on the spirit of the times. The ages grow from more to more and old orders change. More facilities, more centralization, more uniformity, more cutting off the rough and raveled ends of merely old customs, old methods, and old forms crowd round about us. Old landmarks shift; like old scaffolding, they are no longer useful; they only mar the outlook of progress, and with many other curious anomalies let this one vanish and a new era of time reform brighten the coming century.

These observations are respectfully, but confidently, submitted with the hope that the British Association for the Advancement of Science will lend its aid in bringing this important subject before the nations of the world for final consideration.

THE OBSERVATION OF METEORS, WITH ESPECIAL REFERENCE TO THE LEONIDS.

DURING the next few years a large amount of attention will be given to meteoric astronomy in general and to the great shower of Leonids in particular. The present may, therefore, be an appropriate time to refer to a few points connected with this interesting branch. It has often occurred to the writer that it would greatly facilitate the comparison of different materials if observers adopted one uniform method of recording meteor flights. Some merely give estimated compass bearings, and a rough guess at the altitude and inclination of path, others give the place and direction according to conspicuous stars near, others simply mark the courses on a map without reading off the individual positions, while others give the R. A. and Decl. of both beginning and ending of every object observed. It would be a great advantage if every one tabulated results according to the latter method. It can easily be done if the tracks, as observed, are penciled upon a celestial globe or star chart, and the positions read off; and this is a much more exact method than describing the flights by stars near which they happen to pass.

Another point is that the accurate observation of meteors demands a considerable amount of practice. It would, therefore, be a most useful preparation for intending observers of the Leonids if they carefully watched the Perseids of August, Orionids of October, and some other prominent displays, and gained a little practical experience of the work. They would find it of material assistance to them, and it would enable the Leonids to be observed more expeditiously and correctly than must otherwise be the case. Accounts are sometimes published of meteoric showers by persons who are reporting a perfectly novel experience, and it is not too much to say that such descriptions are useless as regards many essential details. A perfect novice may of course stand and count the number of meteors visible, and may be capable of describing a star shower in a general way, but he is heavily handicapped when it comes to recording the more difficult features with precision.

What photography may achieve in meteoric work we cannot definitely foresee, but it is quite certain that the proper observation of meteors, as at present conducted, demands the work of a lifetime. A man must watch for meteors all night, and suitably record them, and by day he must analyze the observations and determine the radiant points. The observer need not, perhaps, absolutely isolate himself from all other work; but the meteoric branch is such an extremely difficult one, embracing, as it does, some thousands of streams which exhibit many different peculiarities, that in order to grapple with the subject successfully he must make it his constant care and the object of his earnest efforts and thoughts during many years.

Fortunately the Leonids are to be classed among that description of meteors comparatively easy to observe and record. They leave streaks for a second or two, and from these the directions are to be determined with great facility and precision. It is also a fortunate circumstance that the radiant point is surrounded by the well known stars in the Sickle of Leo. The lines of flight may therefore be readily carried back in the correct directions by projecting a straight wand upon the streaks, and noting their points of convergence relatively to the stars named.

The writer has usually found the radiant very definitely and sharply defined, and it can be readily fixed to within 2° of probable error. But naked eye observation is capable of much more accurate results than this. If, during a pretty active return of the shower, the observer will independently fix the radiant during, say, successive half hours of the night; he will in this way get eight, ten, or twelve positions, from which he may derive the mean place of the radiant to within about ½° of error.

The Leonid radiant is sometimes described as very diffuse; but this is a false effect brought about by two circumstances which, if properly allowed for, would leave a very definite and satisfactory position. One cause of its apparent diffusion is that meteors are attributed to it which really belong to the minor showers in Leo and the surrounding region, of which quite a large number exist. They display similar visible characteristics to the Leonids, and can only be dissociated from them by the exercise of extreme care in noting their directions of flight. In Popular Astronomy, vol. I, p. 298, I gave a list of sixty-eight meteoric radiants situated in various parts of the heavens, and active during the period November 10-15; and in the Observatory, vol. xx, p. 306, a table of seventy-two circum-Leonid showers was published. Those which chiefly affect the determination of the Leonid radiant are placed near δ and ι Cancri, μ and ξ Ursæ Majoris, λ Hydræ and π, λ, τ and β Leonis. The meteors are swift and usually leave streaks. Another contributing feature to dispersed radiation is found in the unavoidable errors of observation. Great care and habitual practice can, however, reduce these to small limits, and it will be found that the radiants derived from accurate materials will be pretty sharply defined.

The probable error in the case of different observers must, however, vary to a considerable degree, for practice cannot equally eliminate inaccuracy from among them all. In catching and retaining correct impressions of meteor flights, natural aptitude exercises an important influence. It is like a game of skill depending upon the eye, judgment and quickness in execution. Really few will excel, while many will only attain mediocrity, and some must altogether fail to acquire the desirable proficiency, even after years of experience.

The horary rate of appearance of Leonids cannot be exactly determined unless the contemporary showers are considered, and their meteors separated from the true Leonids. Many observers count every meteor proceeding from the general direction of Leo as necessarily a Leonid, and thus the horary number is exaggerated. If an inexperienced observer gives 20 as the number of Leonids seen in an hour, the fair inference is that not more than 14 or 15 of them were true members of that system. During very strong returns of the shower this point may, however, be disregarded, for the minor streams can then exercise very little relative influence on the results, and are virtually obliterated by the superabundance of Leonids.

One new feature to be attempted during the ensuing return of the Leonids is to photograph the meteor group of November, 1866, in space, and an excellent ephemeris of its nearly stationary position in Libra and southeastern limits of Virgo, during the first four months of 1897, was given in Monthly Notices, lvii, p. 70-2. Some people will regard the idea as little more feasible than opening a correspondence with the inhabitants of Mars, and certainly there appears very slender prospect of its successful realization. The experiment ought, however, to be tried. Let us support every project which has a possible side to it, for it is quite clear that many things deemed beyond our reach are capable of attainment by persevering efforts and proper means. Novel attempts of this kind, if seemingly chimerical, should not be hastily condemned or necessarily considered as vain labor. Mr. Roberts' photographic search for a transneptunian planet was a novelty, and it proved vain labor; but who will say that it ought not to have been undertaken? The same may be said of Mr. Barnard's similar search for a satellite to the moon. To look for a fifth satellite of Jupiter was decidedly a novelty in these modern times, and yet it proved productive. Let, then, new researches like these have our encouragement; for if they do not always succeed, they stimulate our interest and enthusiasm, and make the science more attractive by imparting to it a welcome freshness and, perhaps, a touch of romance.

As to the practical aspect of the question, it is fair to conclude that the Leonid group of 1866 is too faint an object to be ever impressed on a photographic plate, especially when its distance is so great as during the past spring, for on March 1 this was equivalent to 800,000,000 miles, and not far short of the mean distance of Saturn! In the great meteor storm of November 27, 1885, when the meteors were more thickly congregated than in the Leonid shower of November 13, 1866, Prof. Newton computed that "the space in the meteroid group corresponding to each single, visible meteor was in the densest portion of the group a cube whose edge is 32·8 kilometers, or 20·1 miles." This means one small pebble in twenty miles of space! The degree of illuminating power exhibited by a group of these bodies, separated by such distances, must be infinitesimally small. If any one were to attempt to photograph Tempel's comet (1866 I), on its return journey, the chances of success would be far greater, for though the comet has still to run eighteen months before reaching perihelion, it is nearer to us than the meteor group of 1866, and must be infinitely brighter, as it doubtless represents the richest part of the stream. We must remember that Tempel's comet passed its perihelion on January 11, 1866, while the meteor group reached it ten months afterward; and it is quite fair to suppose that the meteoric train of the comet, at a distance of some hundreds of millions of miles from the nucleus, must be relatively tenuous as compared with that part in the immediate wake of the comet. The meteors may not, however, show a regular decrease in numbers according to distances from their derivative comet, but may probably consist of a series of groups. There is every reason to believe that disruptions of a violent character affect the physical character of comets, and this was well exemplified in Brooks' comet (1889 V), visible, in 1896, at its second observed return, which was seen separated into five portions on August 1, 1889. There is, however, every probability that the meteor cluster of 1866 is some hundreds of times fainter than Tempel's comet; yet even the latter was not visible to the naked eye in December, 1865, or January, 1866, and indeed the object was only followed for a month in telescopes. It might be a good plan to endeavor to photograph the comet first, and then fish for its associated meteor stream; for the easier objects are sometimes capable of leading us up to the discovery of the more difficult ones.—W. F. Denning, in Nature.

THE AMERICAN LOBSTER.

PERHAPS no other inhabitant of the ocean so important from a commercial point of view as the lobster has been so thoroughly neglected by the naturalist, says Self-Culture. History and literature, from old Grecian days up to the present, abound in references to this curious creature; but it was not until there was an industrial demand for information in regard to artificial rearing that science really turned her attention lobsterward.

But two species of the lobster are known to the economic world, the European (Homarus vulgaris) and the American (Homarus americanus). To the latter species we will confine our remarks, as the most interesting as well as the larger of the two.

While it is difficult to determine boundary lines of marine products, it is safe to say that a belt from thirty to fifty miles wide, and extending from a little above the Straits of Belle Isle to Delaware, would include practically every American lobster in existence. Indeed, this territory includes much barren ground, some parts being too deep, others too shallow. Almost any depth from one to a hundred fathoms is deemed promising, but the favorite territory is much more restricted. The largest lobsters are found toward the north of this belt—a fact which some consider accounted for by the northern grounds being the most recently fished from, and therefore less culled over.

One hardly expects to find in the lower orders a species of intelligence comparable in interest with that of higher animals. We rather hope to be entertained by some novel substitute which nature may have provided for intelligence. One interesting accomplishment of the lobster is its ability when frightened to project itself, with almost incredible speed, a distance of twenty or thirty feet directly into its hole, no larger round than its body. When feeding it walks about quite briskly on the ocean bottom, which it seldom leaves from choice. Occasionally one can be dragged to the surface by thrusting an oar or pole into the burrow and then withdrawing it hastily as soon as the inhabitant has seized the offending stick in its strong claws. Usually, however, this method only brings the lobster as far as the mouth of its burrow, where it angely releases its hold. In aquariums each lobster soon finds its individual retreat among the rocks with which the bottom should be provided, and which it invariably retains and defends against all intrusion.

As warm weather approaches, usually during April or May, there is a noticeable movement of the lobster kingdom shoreward, into water but a few fathoms deep. Late in the fall a corresponding inclination toward deep water occurs. The winter fishing is therefore in twenty-five or thirty fathoms of deeper water than the summer. The time of these movements is very largely governed by the forwardness of the season. Lobsters are very sensitive both to cold and light, their bodies being accustomed to the comparatively steady temperature and the obscure light of the ocean bottom. Exposure in captivity to strong sunlight is in a short while fatal to them.

Popular literature has more than once accredited to the lobster mother the same careful attention to her young that the crayfish gives. As a matter of fact, they receive neither care nor attention from her. As soon as hatched they at once scatter and shift for themselves. The hatching is from May to August, the average date varying somewhat with the location and the temperature or climate. When first hatched the

young lobster is less than half an inch long and in its habits totally different from the adult. The first few weeks of its life are spent at or near the surface swimming about, and it is not until after the fifth or sixth moult that it sinks to the bottom, even then less than an inch in length. At this period of its life the lobster is still shrouded in mystery, his long journey to the ocean bottom completely removing him from observation. Until four or five inches long they are too small to be held in the lobster traps, and too nimble to be approached direct. Sometimes specimens two or three inches long are found under stones near the coast, but from the time they sink into the ocean up to this period they are rarely found.

Perhaps at no period of its life is the pugnacious disposition of the lobster more apparent than during the first few days after hatching. Cannibalism, always a characteristic of the species, now asserts itself to a surprising degree and renders it practically impossible to raise young lobsters in an aquarium. Occasionally one of these youngsters will be found feigning death on being meddled with, but this is too uncommon to be regarded as a characteristic even of the young, and is never met with in adults.

In the matter of food the young lobster does not appear to be very discriminating, and seizes upon almost anything of available size with equal avidity. In its mature state the flesh of fish and other inhabitants of the deep is the favorite dish, and it does not seem very particular as to whether this is fresh or not. The bodies of dead fish are seized very greedily. Occasionally vegetable matter appears to furnish a part of their supply. Weak or injured lobsters, too, are the almost certain prey of their stronger and healthier companions. The food is seized and crushed by the heavy claws before entering the mouth. These claws, its dreaded weapons of defense, in the larger specimens frequently comprise more than half of the entire weight and a length seemingly out of all proportion to the remainder of the body. One monster, captured in the Penobscot Bay, Maine, weighing a little more than twenty-three pounds and measuring twenty inches, bore a crushing claw nearly fourteen inches long and more than sixteen inches in circumference. This lobster, it is estimated, could with ease have crushed the wrist of a man.

A most interesting means of defense, or rather of escape, is possessed by the lobster: that is its power, on demand, to cast off an imprisoned limb and reproduce a new member in a few weeks, the greatest inconvenience apparently to the lobster being its increased susceptibility to attack.

The use of the lobster is too well understood to need mention here, and its preparation for market is hardly within the province of the naturalist. Briefly, it may be said that lobsters are baited with dead fish in slat boxes with funnel-shaped entrances at each end. These are lowered to the ocean bottom and from time to time raised and examined. Once fairly caught, a full-grown lobster very seldom regains his liberty. This method, primitive as it may seem, is effectual enough; so much so that year by year the numbers of the lobster and the range of his camping grounds are gradually diminishing. While statistics show rather an increase than a diminution of the number caught, it must be remembered that this is through a constantly enlarging army of fishermen and traps, and is not due to the supply of lobsters. At the same time, as the old warriors of the deep are caught and give place to a newer generation, the weight of the catch is seriously diminished, even though the number is increased. The decline in pounds in the catch between 1887, when 28,882,188, valued at $799,717, were landed in the United States, and that of the previous year was more than 5,000,000 pounds, while the market value was over $260,000 more in the year 1886. More than 200,000 traps were, in 1892, operated, and over $600,000 was invested in the various branches of the business. The importance, then, of protecting the lobster and preserving the industry to future generations is easily seen, while the wholesale destruction to which it is now subjected is a matter for universal regret. WILDER GRAHAME.

ACETYLENE AS A QUANTITATIVE REAGENT.

ACETYLENE may be employed for the determination of copper. The salt to be analyzed is dissolved in 100 to 200 times its volume of water mixed with a few cubic centimeters of ammonia and heated for a short time on the water bath. Acetylene is then introduced into the dark blue fluid to saturation. The precipitate is complete even in the cold, but it takes place more quickly, and is better aggregated on warming, while at ordinary temperatures a portion often adheres obstinately to the sides of the vessel. In a closed flask the precipitate can be preserved for any length of time without decomposition; in an open vessel a part of the precipitate is again dissolved as long as the fluid remains alkaline. The copper acetylide is now collected, washed and decomposed by being digested for half an hour with hot diluted nitric acid, filtered from the carbonaceous residue and the filtrate evaporated to dryness and ignited. The ash of the filter and residue is also taken and the whole weighed as CuO. The separate ignition of filtrate and insoluble residue is advisable to prevent explosion. A too large excess of acid must be avoided. The acid contained in the original copper salt can easily be detected in the filtrate from the acetylene precipitate. For the separation of zinc and copper, as salts of the former metal are not decomposed by acetylene, the method is most useful. In the presence of excess of sulphurous acid the whole of the copper is precipitated by acetylene in a mixture of a solution of salts of the two metals. In an experiment with a known quantity of zinc, it was found that none was carried down by the copper acetylide precipitate.—Pharm. Centralh., xxxviii, 426.

A table has been made of all the degrees which have been granted by Cornell University. The total is 4,304, of forty-seven distinct kinds. Only two granted in 1896 are honorary degrees. There are LL.Ds. It is significant of the great growth of Cornell and its greater present importance in the educational world, that 3,014, or 70 per cent. of the 4,304 degrees, have been granted in the last ten years.

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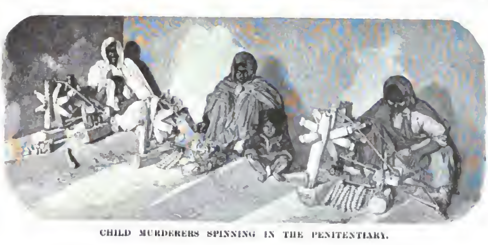
SCENES IN BENARES.

WE publish to-day reproductions of some instantaneous photographs taken by Dr. Borek, of Dresden, during his last visit to Benares, that Mecca of the Hindu, so renowned for its fifteen hundred temples. This city is full of interest to any one who wishes to make a study of the customs of the natives, but he will probably find it difficult to penetrate the barrier they draw about themselves. The Hindu servants and guides will take a stranger about the city showing him temples and things of general interest until he is worn out, but they are seldom willing to introduce him to the real life of their people. If told that the visitor wishes to go to the Ganges early in the morning to see the bathers, they will find some excuse, such as not being able to get boats or boatmen; so that the traveler who finally reaches the sluggish, muddy river later in the day has no conception of the entire change in the physiognomy of the stream when seen in the delightful coolness of the early morning hours when only representatives of the highest classes, rajahs and Brahmins, bathe by the light of the moon or of dawn. Noble ladies and beautiful girls wrapped in light colored muslin stand in the Ganges and pour water over their limbs from their little bowls or "lotas," putting aside the custom of seclusion usually so carefully observed by women in Benares. Each hour brings a lower class of bathers, until only the lowest are seen upon the banks, and this is the time that the smiling guide chooses for showing the river to the European. It is the same with everything he wishes to see. In the temples he finds miserable beggars and Brahmins of low rank, but the doors of all the mysterious "sooms," cloisters and places where those who wish to hide from the Europeans seek refuge as penitents, are closed to him. One of the most interesting of these places is shown in one of our illustrations. This cloister is of historical importance as the hiding place of the last independent rajah who was driven from his palace in the last century by Warren Hastings. He felt safe here among the Shiva idols, the old lingams over which he so often piously poured the sacred water of the Ganges, milk and melted butter, as other penitents now do; for he knew that even Warren Hastings would not ignore the prohibition of the Brahmins by entering their religious retreats. ... "soom" ... are passe... worship of ... gam idols by ... ndus who are ... from Benares as ... yassis, or people

WOMEN GRINDING CORN IN THE PENITENTIARY.

CARPET WEAVERS IN THE PENITENTIARY.



CHILD MURDERERS SPINNING IN THE PENITENTIARY.

voluntarily leave behind them all their worldly property, all that adorns life, to spend the rest of their days under some distant sacred banyan tree as lonely hermits. One of these Sanyassis is shown at the right in the engraving. He will wander away from here to solitude clad only in a cotton cloth, an antelope skin over his shoulder to be used as a bed, a chain of seeds around his neck, on which to count his prayers, and in his hand his "lota." Those who belong to this sect are not allowed staffs until they are more than sixty years old.

Innumerable pilgrims are always traveling to Benares. Many who are sick or dying go there by railroad, in palanquins or ox carts, or on the backs of elephants or camels, so as to die near the sacred Ganges. Death has no terrors for the Hindu who knows that his ashes will be intrusted to the "eternal Mother Ganga." One needs strong nerves to visit the Munikarnika Ghat, or Burning Ghat, as the English call it, especially during epidemics, when hundreds are burned every day. If a Hindu dies in his house, he is wrapped in a shroud of white or yellow, with red spots, placed on a rough bier and carried out, not through a door, but through a hole that is made in the wall, and then immediately closed up again, so that the departed soul shall not find its way back to those that are left. The body is then carried to the bank of the Ganges and is often left where the river can wash it and the sun beat upon it, like the one shown in our engraving. It never occurs to a Hindu that the sacred river can carry contagion. If the sick man dies close by the Ganges, a handful of mud from the river is pressed on the blanching lips, then the body is placed on the bier, dipped in the Ganges and finally packed in the pile of wood or dried cow manure. In building the piles, four strong posts about five feet high are driven firmly in the ground and the pile erected between them, so as to prevent its falling apart when burning. When half of the pile has been laid, the body is placed upon it, the relatives and friends scattering pieces of sandalwood over the body, and then the pile is completed. Then the chief mourner, who must be the son of the deceased, or, in case of the absence of the son, his father or brother, walks three times around the pile and fires it with a sweet smelling torch of sandalwood. After performing this ceremony, he withdraws to have his hair cut. Our engraving shows the chief mourner and the barber on the steps a little above the funeral pyre. After having given expression to his grief

in this manner, he joins the other relatives and together they wait for the body to be reduced to ashes, which are then collected in an earthenware jar and consigned to the Ganges.

The multitudes that flock to Benares from all parts of India are taught that they must respect the English laws or be sent to the central jail or the district jail. These jails are superintended by Europeans who are assisted in the performance of their duties by well behaved convicts. The prisoners have to work at the potter's wheel, in the kitchen, as painters or as blacksmiths, or at other occupations, according to their caste. One of our illustrations shows carpet weavers working in their old fashioned way, drawing the weft threads with their toes while their hands are otherwise employed. It is surprising to see how carefully the English respect the caste privileges even here in the prison. The Brahmins are not only allowed to keep by themselves while at work, but their food is cooked separately by cooks of their own caste. If a Brahmin is to receive a whipping, the cat-o'-nine-tails is used upon him only by a fellow prisoner of equally high caste. Another engraving shows a prisoner leaving his cell to be executed. He was a chief captured in the war against Burma and he defended himself against a keeper who was torturing him—a capital offense!

One of our engravings shows women grinding corn in the prison. Some of these women are clad in white and some in yellow, the latter color indicating that their crimes are serious enough to merit transportation and that they will be carried by the next transport to the Andaman Islands. Each of the women wears around her neck a steel ring to which is attached a wooden pendant bearing the record of her crime and stating the length of time she is to be imprisoned. In the neighboring spinning room there was, when the photograph was taken, a woman dressed in yellow who was to be taken to the islands the next day, because she had killed her two little daughters. The authorities had shown her the questionable kindness of allowing her little son to spend a few hours with her before her departure. Superstition and the inexorable laws of caste made a criminal of this woman. Her caste required her to celebrate the marriage of each daughter with a display far beyond her means, and superstition told her that she would be doing a good deed if she sacrificed the little girls to the elephant-headed god Ganesh, and that as a recompense these two girls would be born again to her as boys; so they were put in a kettle of boiling milk before the picture of this god. Formerly large sums of money were given to Brahmins to induce them to assist in this way in reducing the number of women, which was undesirably large.

It is pleasant to turn from all this misery to the beautiful poppy fields, which are such a rest to the eyes after having looked for a length of time upon the blinding yellow walls of the prisons. The region most celebrated for the cultivation of the poppy and the manufacture of opium lies between Benares and Ghazipur. Our engraving shows a woman cutting the green poppy heads, for which purpose she uses a knife consisting of five blades bound together, while the man who follows her catches the juice in an iron ladle. The overseer watches carefully to make sure that none of the valuable fluid is purloined. Even the water used in washing the wooden moulds in which the cakes are pressed is boiled down, so as to save even the diluted opium.

Dr. Boeck completed his collection of pictures by taking one of himself and the men who served his supper at the Dak Bungalow, where European travelers usually stop. He had proposed before to take their pictures, but, as Mussulmans, they were bound to respect Mohammed's law prohibiting portraits (waiters are always Mohammedans), and therefore refused to sit for him. Now he decided to take an instantaneous picture without their knowledge. While they were preparing the meal he arranged the camera, the flashlights were lighted at the proper time, and their pictures were taken with his own.


BURMAN CHIEF GOING TO EXECUTION.

For the accompanying engravings and the above details we are indebted to Ueber Land und Meer.

A GREAT SOUTH AMERICAN WATER SYSTEM.*

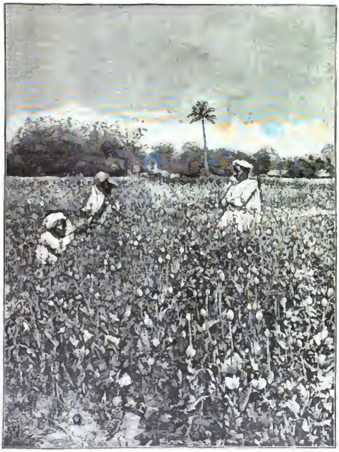
As is well known, the trade winds sweep along the equatorial belt across the Atlantic Ocean from east to west at stated and well-defined periods of the year. On encountering the South American continent they are not detained in their course, as the land is low and extends westward in vast expanses of plains not unlike the Russian steppes or the pampas that form the territory of the Argentine and the other republics that lie toward the extreme south of the continent.

The course of these trade winds is only stopped by the mighty Cordillera of the Andes, which runs along the whole of the South American continent, not far from the coast of the Pacific Ocean. It is on the summit of these mountains that all the moisture gathered by the winds during their long flight is deposited. In some parts the height is such that, notwithstanding the fact that the locality lies in the very heart of the tropics, the moisture crystallizes into snow and melts slowly. In other altitudes it condenses into water and flows downward, forming a series of torrents and streams which precipitate themselves along the mountain flanks, seeking the lower levels.

Two great water systems are thus formed, one toward the south of the equator—that of the Amazon—and another some degrees to the north, and above the equator—that of the Orinoco; the first one the largest river in the world, and the other the third largest stream of water known, since it is only excelled in volume by the Amazon and by the Congo.

The Orinoco is to all intents and purposes an inland sea. Like the ocean, it has calms and tempests, and at times its waves lash with fury the sands and the rocks along its banks. It was first discovered by Columbus, who sailed across its mouth, but did not venture inland. Toward the fourth decade of the sixteenth century Diego de Ordaz entered the river, and after navigating its course for about twelve hundred miles, deviated into one of its most important tributaries, the River Meta, which he ascended until he found himself not far from the first spurs of the Cordillera which dart into the plains. Here he abandoned his ships and betook himself to the land, climbing the abrupt sides of the mountains, until he arrived at the vast plateau of Bogota, the seat of the empire of the Muiscas and the Chibchas, second only in its power and development among those found in the new world, after the discovery by Columbus, to those of the Aztecs and of the Incas in Mexico and Peru respectively. Here he encountered two other expeditions of Spaniards who had come, the one from the north, from the shores of the Atlantic, and the other from the south, having entered the continent by the Pacific coast, all in quest of gold, searching for that

* Contributed by Senor Don Santiago Perez Triana, who has lately returned from a canoe voyage on the Orinoco, and published in the Journal of the Society of Arts.


OPIUM HARVEST.

famous Eldorado which lured the conquerors of the new world from one region to another and from one zone to a more remote one.

The aspect of the Orinoco, with very slight alterations to be found at places far distant from one another, remains the same as when the daring Spanish adventurers navigated its waters for the first time. Its course runs first from south to north until it encounters a low range of mountains, or rather hills, which deviate the stream into an easterly direction. A struggle of centuries must have taken place at this spot where, along a stretch of about thirty miles, the river is incased within very narrow limits, and rushes madly between the granite walls on either side, and plunging into deep and wide hollows, where the waters froth and bubble, and seem to rest prior to darting again through other and similar straight passages, and so on until they reach the open plains, and follow their course uninterrupted to the sea.

These rapids divide the river into two well defined parts—the Upper and the Lower Orinoco—and have acted as a barrier, which has kept the lands and the rivers beyond it almost unknown to and unexploited by man. One detail is worthy of mention, namely, that the rapids of the Orinoco are not due, as is the case of other great rivers, to a sudden and great descent of level; they are the result of the compression of an immense volume of water into a very narrow channel, studded with mighty rocks, which have withstood the onslaught of the waters, a channel along which the waters rush with extreme violence and rapidity.

The numerous tributaries that form themselves into the lordly current known as the Orinoco flow into it in all directions, from the north, from the south, from the east, and from the west. Most of them are navigable and receive other affluents, which in their turn are navigable also, so that the whole system constitutes a vast and prodigious network of rivers, carried deep into the very heart of the continent, to the foot of the mountains, and into the inmost recesses of the forests and plains. This network is, in truth, a complicated system of natural highways, which, were they placed longitudinally, would attain a length of many thousands and thousands of miles. Besides the running waters of the rivers, there are certain other water channels called caños, which connect some of the rivers with the others in a similar way to that obtained in other countries by means of artificial canals. Among these the caño of the Casi Quiare deserves special mention, as it connects the system of the Orinoco with the Rio Negro, which, in its turn, forms part of the Amazon system, so that those two great inland seas, the Orinoco and the Amazon, are united by these means.

Two well defined seasons divide the year in the vast valley through which the Orinoco tends its course—the wet season, lasting from May to November, and the dry season from November to May. The trade winds blow during the dry season and clear the atmosphere from the miasmas and exhalations of the soil, purifying it and rendering the climate cool and salubrious. Evidently the influence of population would tend to make these regions far more healthy and inhabitable than what they are to-day.

The forests abound in all sorts of natural wealth; precious timbers, medicinal and resinous plants, India rubber, and all the best known and most highly prized of the tropical products are found in exuberant abundance. The plains themselves are covered with natural grass, which affords the best kind of pasture, whereon the flocks thrive and multiply as rapidly as anywhere else on the surface of the globe; but little use is as yet made of all this immense supply of natural wealth. Along the Lower Orinoco there are some large cattle estates studded here and there, at immense distances from each other. On the shores of one of the largest tributaries, the Caura, and those of the Orinoco itself near the Caura, large forests of tonga bean—a species of aromatic almond used for medicinal purposes and for the preparation of perfumes—have been discovered and exploited for quite a number of years. Some few attempts at exploiting the rubber forests have been made with fairly good results, but this may be said to constitute all the work thus far done toward exploiting these regions.

The only city deserving that name which is found on the Orinoco is the old city of Angostura, now Ciudad Bolivar, named thus in memory of the liberator of the northern republics of South America. It was built by the Spaniards on a bluff overshadowing the river, 300 miles from its mouth, at a place where its waters are

LINGAM IDOLS AND PENITENTS.

THE BURNING GHAT ON THE GANGES.

PORTRAIT OF DR. BOECK IN THE DAK BUNGALOW.

encompassed within a very narrow strait, as the word Angostura indicates "narrowness." From this city steamers ply up the stream about every fortnight as far as the river Apure, two or three hundred miles to the west, and then turn into that river and up to the old city of San Fernando; and this is the sum total of the present navigation existing on the Orinoco, with the exception of the ocean steamers that penetrate into the river from the sea, and sail as far as Ciudad Bolivar.

The lonely traveler paddling along slowly in his canoe, or sailing along with the wind, when it is favorable, contemplates the exuberant natural wealth displayed on both shores of the river as they pass before his eyes, admires the magnitude of the numerous affluents that flow into the main stream from either side, and unconsciously forms the conviction that all these vast natural elements must necessarily be destined to form some day the basis of a mighty center of civilization and human industry, toward which end Nature has so lavishly contributed all her gifts, even to the facility of means of transportation, the highroads open to commerce, without which no people can attain greatness or large industrial and commercial development.

Beyond the rapids, that is to say on the Upper Orinoco, the forests are thicker, the affluents more numerous, and the climate healthier. Many tribes of Indians still remain scattered in these boundless regions. They are of a tame and peaceful disposition, and can be brought under the sway of civilization without any great effort or difficulty.

One special source of wealth attracts the eye of the traveler in the Upper Orinoco and its affluents. That is the abundance of rubber forests of identical quality to those which are to be found on the Upper Amazon. At the present day rubber forests are being sought for in all directions, and yet those of the Orinoco seem to be forgotten or ignored.

The republics of Colombia and Venezuela are the owners of the immense regions watered by the Orinoco. Little is known in either of them about this important part of their territory, and certainly no efforts are being made to obtain from it the products which it so abundantly offers. The problem of exploiting these vast regions is not one of difficult solution. A few steamers on the lower river, a few more on the upper and its numerous tributaries, and some sort of railway along the banks to connect the two parts of the river, facilitating the passing of the rapids, is all that is required. It is a work to be undertaken with the protection of the two governments, as from the moment that private individuals can be sure of the means of transportation, they would flock to those regions, where wealth can be obtained with more certainty and less danger than in the gold fields now and anon found in different parts of the world, to which thousands are attracted, and where so many hopes and so many lives are destroyed and lost.

It is to be hoped that this vast region will ere long attract the attention of those able to place it within the reach of modern industry and commerce. Energies that lie latent in the old world, and ambitions that are unsatisfied, would find on the Orinoco and its shores an ample and remunerative field.

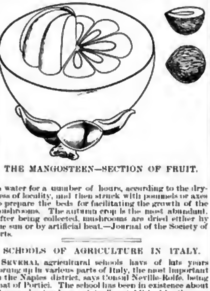
THE MANGOSTEEN.

Thanks to the courtesy of the authorities at Kew, we have been enabled to taste a ripe fruit of the mangosteen, grown in Trinidad, and sent home by Mr. Hart. The fruit is of the size of a small orange, leathery, purple, with a thick green four to five leaved calyx at the base, and a sessile four to five lobed stigma at the top, the stigmatic lobes long, club-shaped, flattened. Each seed is enveloped in a white or pinkish juicy pulp, which has a very delicate and agreeable flavor, though it does not here bear out the eulogistic verdict of travelers. The thick, leathery rind offers ample protection, so that its importation should be easy. In 1875 similar fruits were sent us by Mr. Prestoe, also from Trinidad.—Gardeners' Chronicle.

THE MANGOSTEEN (GARCINIA MANGOSTANA).

JAPANESE MUSHROOMS.

Mr. Robert P. Porter, who has been conducting investigations into the industries of Japan, states that one of the most interesting studies in that country is the growing of mushrooms in the Shikoku Island, where most of the camphor is produced. This is an important article of export, mostly to China, and during the year 1895, the last year for which the returns are available, the quantity of mushrooms exported from Japan to all countries amounted to 1,780,307 lb. Of the numerous species of edible mushrooms, the one called Shiitake is the most important, being abundantly exported abroad and also used for many culinary purposes at home. Logs which are used for cultivating this mushroom are various species of oak. The principal districts where this mushroom is produced are the provinces forming Shikoku, Kiushiu, Wakayama, and Shizuoka prefectures. Oak trees 25 to 33 years old are felled in the autumn, and incisions made with axes at intervals of 3 or 4 inches, the incisions generally reaching the woody layer. The trees are then cut into logs of 4 to 5 feet in length and left in dark secluded parts of the forest. After the third year, mushrooms make their appearance in the incised portions. When the growth lessens they are replaced by new logs. The mushroom grows at each season of the year, winter, spring, summer and autumn, but the growth in winter and spring is the result of artificial stimulus. The logs are steeped



THE MANGOSTEEN—SECTION OF FRUIT.

in water for a number of hours, according to the dryness of locality, and then struck with pommels or axes to prepare the beds for facilitating the growth of the mushrooms. The autumn crop is the most abundant. After being collected, mushrooms are dried either by the sun or by artificial heat.—Journal of the Society of Arts.

SCHOOLS OF AGRICULTURE IN ITALY.

Several agricultural schools have of late years sprung up in various parts of Italy, the most important in the Naples district, says Consul Neville-Rolfe, being that of Portici. The school has been in existence about 24 years, having been originally established by the province, but it was taken over by the state, and re-established by royal charter in 1885. A portion of the disused Royal Palace was given over to its use, the spacious grounds, gardens, and useful group of farm buildings being especially adapted to that purpose. The instruction is conducted by sixteen professors, each of whom takes his own branch of the subject, as chemistry, botany, horticulture, zoology, entomology, geology, farm accounts, meteorology, physics, forestry, irrigation, etc., and lectures upon it. The course occupies three years, after which students who satisfy the examiners obtain the degree of Laureato Agronomo, or bachelor of agriculture. Besides the lectures, practical instruction is given in the field, and the making of cheese, wine and oil is systematically carried on. It is, in short, an agricultural university; 670 scholars have passed through the school, of whom 228 have obtained degrees, and there are 21 freshmen inscribed for the coming year. Most of the laureates become professors in other colleges in Italy, and some have gone to other places, such as Cairo, Buenos Ayres, and San Francisco. One very useful branch of the institution is the exhibition of agricultural machinery, upon which the future of Italian husbandry depends so much, and another the dissemination of pamphlets by the various professors on their special subjects. Of these last there is a very interesting one by Professor Italo Giglioli, the head of the school, on the importation of Italian fruit into Great Britain. He begins by stating that the total importation of fruit into the British Isles has risen from £5,977,351, in 1880, to £7,287,566, in 1890, with a steady annual increase. Besides this, in 1890, nuts to the value of £622,936 were imported. In 1890, only 4 per cent. of the fruit imported into Great Britain came from her own colonies, and 8 per cent. from Italy, but the professor is strongly of opinion that while the colonies have increased their export to a very large extent, the next decennial period will show that Italy has not been idle, and that with more attention to cultivation, packing, and means of transport, the Italian fruit will obtain a more influential place in Great Britain, which is shown to be the most influential fruit market in the world.—Journal of the Society of Arts.

AGRICULTERAL POSSIBILITIES OF THE YUKON VALLEY.

No doubt many on this coast, says the Mining and Scientific Press, San Francisco, Cal., will be interested in a sketch of the agricultural possibilities of the great Alaskan valley, which is now so prominent in the minds of gold seekers. It is from a Minnesota man, and the California reader will of course remember that his standards of comparison are very different from those a Californian would employ. The following is from a correspondent residing in Faribault, Minnesota:

The Alaskan Winter.—The winters in the Yukon valley are not much different from those of northern Minnesota in their influence upon the white man. The cold is more prolonged and severe, but the extreme dryness of the air, in a large measure, offsets this difficulty, and a man who has labored outdoors through a northern Minnesota winter will not notice much difference in the cold of the two localities in its effect upon his constitution. On the Yukon there are frequent periods during the winter when a man must desist from all outdoor work, and the thermometer drops down to 70° below zero, but I have on several occasions seen the mercury go as low as 60° below zero in Minnesota. From this, it appears that the cold is not to be regarded as so great an obstacle of that region as it has usually been.

Area and Soils.—The Yukon valley is so vast in extent that it is difficult to realize its size, and a very large portion of it is identical with the Red River valley of Minnesota in formation and in soil. The upper terraces of that portion of the Yukon valley which lies below the point where the river makes its exit from the mountains are immense level tracts of deep, rich soil which are only slightly broken at long intervals. So level, indeed, are these flats that the eye can seldom detect any change in the surface on them, and a furrow twenty-five miles long might be turned in many places without a break. The Pacific Ocean exerts a profound influence on the climate of the valley, and the changes of the seasons are wonderfully abrupt and decisive. When the spring comes, the sudden disappearance of the ice and snow, and the bursting forth of green verdure, are all but magical. The quick growth of plant life, and the perfection it attains, are truly remarkable. But it seems to be fully accounted for when the conditions of soil and climate that exist in the valley are understood. During the summer the ground never entirely thaws out. The surface is quickly released from the frost to the depth of 4 to 10 feet, according to location and character of the soil, and this frozen state of the subsoil is the principal factor in the growth of plant life. The summer is one long day of three months' duration. The sun swings round in a circle and is above the horizon from twenty-one to twenty-four hours each day, so that, for this lengthy period, it never becomes dark, and the ground has no chance to chill; no frost falls, and the thermometer ranges from 90° upward in the sun during these three months.

Moisture and Crops.—Again, the dryness of the air renders this prolonged, excessive heat as easy for man to withstand as a 75° to 95° temperature in Minnesota. It is seldom that rain falls during this short but potent summer, and storms of wind and hail are unknown. But the more prolonged the drought and heat may be, the quicker and more perfect is the growth of all plant life present, and the wide valley is clothed in deepest green during these summer months. The secret of this is that an abundant supply of moisture is furnished by the frozen subsoil, that slowly thaws and steadily releases the water stored in it, which is brought to the surface through the channels of capillary evaporation. This moisture is but slightly above the freezing point when it is absorbed by the roots of the growing plants, and it must exert a highly beneficial influence by counteracting the fierce heat that steadily assails the surface of the ground. Under these peculiar conditions of the natural forces of nature it is easily realized that a number of our staple crops will succeed and reach perfection in the Yukon valley. Scotch Fife wheat produces enormous yields of the very highest grade of that grain, which has been proved, by test, to make the best class of patent fancy flour. Barley and oats, potatoes and roots of all sorts and many of the garden vegetables, also reach surprising perfection. In the case of barley grown in the Yukon valley, the malt makers would likely find the very highest grade of grain for their use, which might soon take precedence throughout the world. The growing barley would not be subject to the vicissitudes it is in the States, and especially it would escape the injury from rains during harvest, and when standing in the shock, which lowers the quality of this grain more than any other.

Present State of Farming.—There are already a number of small farms in the valley which have been opened by disappointed gold seekers, and it is from the results secured on these that I have drawn my most trustworthy information. These farmers are reaping a rich harvest of dollars. The miners stand ready to pay high prices for vegetables, and even for grains, which they grind into coarse meal for bread. This is the golden side of the picture of prospective farm life in that semipolar region.

The Drawbacks.—But there is a darker side to life in that far northern country, which will likely appear to those used to the comforts of farm houses in the States as insurmountable. The long, cold winter, with its constant night of nearly three months, when the landscape is wrapped in deep gloom, and when only a faint flicker of twilight and the changing play of the aurora borealis shining on the white snow reflect a faint, uncertain light, is likely to give a dubious aspect to the Yukon country. This dismal and dangerous period of the year, coupled with the incredible swarms of mosquitoes and flies in the summer, which make it impossible for horses or cattle to exist, seems to outweigh the favorable features of the valley. Mules and

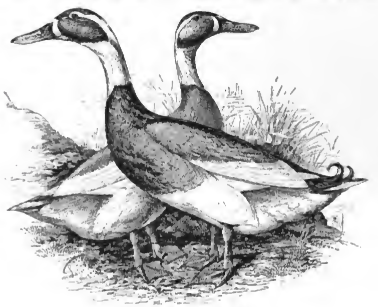
the reindeer will be the beasts of burden in that country if it be ever brought under cultivation. Sheep and hogs will, no doubt, be easily acclimated, and goats may take the place of the cow. The reindeer is a very valuable animal. It makes an excellent beast of burden, furnishes good meat, is easily reared, and is in its native home in that climate, and will take the place of the horse and the ox.

Anticipations.—If, however, a railroad should be built to connect the great Yukon valley with the commercial world, and wheat growing prove to be a profitable business there, the work would likely be done mostly by steam. There is plenty of coal in all districts of the valley, which will furnish cheap fuel for every purpose. On those great flats a traction engine can run a gang plow, turning furrows miles in length, and fields of 50,000 or more acres of wheat would likely be a common sight. The people could live in villages for mutual protection, and in the spring, summer and fall carry forward their farm work on the largest scale. Here the bonanza farm would find its true sphere, with room for all who wished to enter that class of business, and the great Yukon valley could be made to supply the marts of the world with the very highest grade of wheat that would, no doubt, command a better price than that of any other country. Neither are we to presume that this is a painting of the fancy. It will likely become a reality at no distant date.

INDIAN RUNNER DUCKS.

A VARIETY of duck has within the last few years attained a measure of popularity, known as the Indian runner; but has been bred for a long period—some claim for more than fifty years—in Cumberland and North Lancashire. It is a small bird, but the flesh is very good, and it is an abundant layer of medium sized eggs, having the further virtue of commencing to lay long before other ducks begin operations, which is an important consideration.

The evidence as to the origin of this duck is not very clear, but it appears to have come from India. Mr. J. Donald, who has done much to popularize the runner duck, says on this point: "A drake and trio of ducks were originally brought from India by a sea captain to Whitehaven, and presented to some friends, who at that time followed the occupation of farming in West Cumberland. Their extraordinary laying properties, producing a supply of eggs long before ordinary ducks commenced to lay, and continuing long after they had ceased, was sufficient to very strongly impress the economic mind of the Cumberland farmer, and for long they were exclusively in this one man's hands; but after their fame as layers extended, the drakes were eagerly sought after, and largely employed to cross the ordinary farmyard ducks of the country, with a view to improving their egg-producing qualities. Another consignment was imported by the same gentleman some years later, and from these two importations it is probable that all the present day runner ducks are either directly or indirectly descended. They were not known to their introducer by any special or distinctive name, having simply attracted his attention when ashore by their active habits and peculiar penguin carriage."



INDIAN RUNNER DUCKS.

These birds are very active, excellent foragers, and specially useful in keeping down slugs and worms in gardens, obtaining a great portion of their food in this manner. They are, as already stated, remarkably good layers, which quality, combined with great vigor, is their chief claim to popular favor. The flesh is small in quantity, but excellent in flavor, and they do not fatten at all well. They are, as a rule, non-sitters, and when broody, which is seldom, are by no means reliable.

Quoting again from Mr. Donald, the following is that gentleman's description of the breed: Both drake and duck should be close and tightly feathered, with very erect carriage. Compared with other domestic ducks they are small, their average weight being from 3½ pounds to 4½ pounds each. They are alert and sprightly, with very active habits, nearly always being on the move. The head is fine and comparatively flat, with the eyes high up. The bill is very strong, at the base broad and long, coming straight down from the skull, giving it a wedge-shaped appearance. The neck is long and very fine, a character which is seen in its greatest perfection during the spring months, more especially in ducks when in full lay. The body is long and narrow, elevated in front, and the head carried high, giving a peculiar erect carriage when on the move; but the carriage is not so much of the penguin form now as formerly, and whether this effect is owing to climatic influences, the introduction of foreign blood into many strains, or to in-breeding, it is difficult to say with accuracy, but probably they have all shared to a greater or less degree in producing this effect.

The head of the duck is a faint grayish fawn and that of the drake a bronzy green, with a narrow band of white running round the base of the bill at its junction with the head in both duck and drake. The bill of the duck is a dull cucumber shade, while the drake has more of a yellowish green. The colored parts of the body of both drake and duck are of a soft fawn shade, that of the drake being finely pencilled, and giving it a somewhat deeper reddish brown tinge toward the upper part of the breast, while the feathers of the duck have a brownish center to each feather, and a fine lacing of a lighter buff shade at the margin. The upper part of the tail and curl feathers of the drake is of a darker shade, somewhat resembling the color of his head. The legs in both duck and drake are orange red.

Hitherto the Indian runner has not been much used for crossing, but at the Royal Agricultural Show at Manchester, in June last, the first prize in cross breds were Aylesbury and runner cross, and they were splendid in quality, very fleshy, and only a few ounces in weight below the Aylesbury and Pekin cross. From this it would appear that the cross is better than we expected, and it is one which deserves further attention. —Edward Brown, F.L.S. We are indebted to the Gardeners' Magazine for t e cut and copy.

THE KLONDIKE PLACERS.*

WHEN the attention of the world was called to the new Canadian gold fields during the past summer, few people had ever heard of the Yukon placers. Nevertheless, prospecting has been carried on for over fifteen years throughout the whole length of the river, both in the northwestern territory of Canada and across the border in Alaska. The number of gold diggers at work tended to increase from year to year, but the severity of the climate and the difficulty of getting supplies into the country checked its progress, especially before 1892, when the first steamers were placed on the river by a trading company. In 1896 the total production of gold amounted to little more than £100,000, with about two thousand miners at work, and although some of this was produced on the Canadian side of the boundary, little attention was paid to it by the Geological Survey of the Dominion, and it was reported as if it were a part of the Alaska output.

On September 6, 1896, however, Mr W. Ogilvie, the surveyor of the Yukon district, reported to the Canadian government that rich discoveries of gold had been made on Bonanza Creek, a tributary of the Klondike, which flows into the Yukon some fifty miles southeast of Fort Cudahy, where he was stationed, and about the same distance from the United States boundary. Mr. Ogilvie continued to make reports during the winter, and, from his book on the subject, lately published by the Dominion government, most of the following information is obtained. The discovery was made by G. W. Cormack, who had been in the country since 1887, and a rush from Cudahy at once took place, two hundred claims extending twenty miles along the creek being staked out within a fortnight of the time when the strike became known. Later on, when the neighboring creeks El Dorado, Hunker, Dry Fork and West Fork were found to promise well, the other diggings on the Yukon were almost entirely deserted. Miners traveled with sleds over the snow from Circle City and other places still farther off in United States territory, and by January, 1897, two thousand men were encamped on and around the Klondike, with scanty supplies and little protection against the cold, although a temperature of 50° below zero Fahrenheit was not unusual. Many men bought a share in the claims even as early as this for thousands of dollars, and the few laborers who preferred to work for hire received one and one-half dollars per hour, working as long as they liked.

Little gold was actually recovered in the winter, the "pay dirt" being dug out and piled up to wait until the spring, when the frost had gone and water was plentiful. Some extraordinary yields were announced, however, as the result of prospecting washings, two hundred and fifty dollars in a pan (containing about one-quarter of a cubic foot of gravel) being reported, but not generally believed. There is little doubt, however, that from one to ten dollars per pan was usually recovered in El Dorado and Bonanza Creeks, although the diggers, as is their wont, were very reticent.

In spite of this reticence and the lack of communication with the outside world, news of important discoveries leaked out, and in the early spring the rush into the Yukon basin from British Columbia and California was unprecedented. By May over two thousand people had entered the country by one route or another, and were pushing on to the Klondike, where the town lots of Dawson City had been staked out, and building was in progress. At the beginning of July the population of Dawson City had risen to five thousand, and more people kept coming in; but the supplies brought by them were far from being adequate, so that the scarcity of provisions continued almost unabated, and as the summer wore on became more and more pronounced, until it was evident that the seven thousand people who will be shut up there in the ensuing winter must suffer serious privations, if not absolute starvation, before the Yukon River becomes navigable again next spring.

Meanwhile, about July 15, the first miners from Klondike reached San Francisco, bringing with them about £400,000 in gold, and the excitement, which had been growing on the Pacific seaboard, became intense, and spread over the whole of the United States and Canada, and even reached England. Thousands of people started for the Yukon without sufficient supplies, and regardless of the fact that it was already too late in the season. Fortunately, the means of transport failed. The steamers on the Yukon were delayed, owing to the lowness of the water in the river; and the difficulty of transporting large quantities of stores over the passes leading from the seaboard to the interior prevented the southern route from being used by the majority of the emigrants, so that not one in ten of those who started late in the summer succeeded in reaching the Klondike, and starvation, if it comes, will not be largely due to the newspaper boom of July and August.

Turning from the history of the district to the description of the gold fields themselves, it may be remarked at once that the placers, which have caused so much excitement, do not present any very unusual features. The gravels are in general about 20 ft. thick, and, as usual, the parts immediately overlying the bed rock are the richest. The pay dirt is, however, said to be frequently 5 or 6 ft. thick, and about 30 ft. wide, the whole width of the creek beds varying from 100 ft. to 600 ft. or more. The gold is very coarse, and is, therefore, easy to save with crude washing appliances. It is of lower standard than most placer gold, containing only about 800 per 1,000 of gold, while the average fineness of Californian gold is about 880 and of Australian about 950. No very large nuggets have been found yet, the largest recorded being worth about £3 10s., and in this particular the placers resemble those of the Pacific coast generally, where large nuggets are very scarce.

Mr. Ogilvie considers that the auriferous gravels have been derived from the crystalline ro[illegible] lying to the south of the Klondike, between it and [illegible] River, which also contains gold, but no [illegible] been brought forward as to their age. A[illegible] point in connection with the question of age is that the ground remains perennially frozen, on[illegible] being thawed in summer to the depth of [illegible] feet. It would appear, therefore, that, like the placers of Siberia, these deposits have remained undisturbed and unaltered ever since the glacial period, and perhaps some such evidence of this will, in course of time, be discovered as was afforded by the remains of mammoths and other animals in the Siberian frozen mud.

It is worthy of note that the comparative lowness of standard of the gold is, under the existing conditions, in favor of the view that the placer gold is derived from the erosion of auriferous quartz lodes formerly existing at a higher level, and has not been formed in situ by being deposited from solution. For, according to those who support the former view, placer gold becomes of higher standard than reef gold after it has found its way into the drifts, the base metals being gradually removed by the solvent action of running water, in which gold is not readily soluble. Since, however, the Klondike gold has been frozen up during a large part of the time since it was deposited in the gravel, it is obvious that it cannot have altered in composition so much as the gold in river sands further south, and might be expected to resemble the gold in the parent lodes, which is not usually more than 800 fine. The low standard of the gold is not so readily accounted for by the accretion theory of formation of placer gold. Some auriferous veins have already been discovered both in the creek valleys and on the mountains round them, although no direct evidence has yet been adduced to connect these lodes with the sources of the placer gold. Moreover, many nuggets have been found adhering to quartz, so that the weight of evidence appears to be in favor of the view that the gold in these placers, at any rate, has been laid down there by mechanical rather than chemical processes.

The method of working the placers resembles that followed in the frozen placers in the transbaikal in eastern Siberia. Prospecting is done chiefly in the short summer when the snows are gone and water is plentiful, but the excavation of the gravel is best carried on in winter, when nothing else can be done. The shafts are sunk to the pay dirt, and tunnels are then run through the gravel, following the rich material wherever it may be. To soften the ground a pile of wood is placed against the end of the drift and set on fire, the gravel, to the depth of about one foot, being brought down by pick and shovel after the fire has gone out. As M. Levat points out in speaking of the Siberian placers (Engineering and Mining Journal,

* From Nature.

June 12, 1897, the method is not an ideal one, but the circumstances are difficult. The frozen soil cannot be easily worked with the pick, as it does not break, but simply mats together under a blow. For the same reason powder and dynamite have little effect; moreover, the drilling of the alluvium through which quartz bowlders are scattered is a slow and costly work. The gravel is piled up to await the arrival of spring, when it is washed in the cradle or in short sluices, which are expensive, owing to the high cost of timber.

The future of the country can hardly be foreseen as yet. It is certain that next year hundreds of miles of unworked creek beds will be vigorously prospected by the thousands who will enter and find that all the ground on the tributaries of the Klondike is already occupied. If, as seems likely, other fairly rich placers are found, many of the men will remain in the country, and with the development of the auriferous quartz lodes and the beds of lignite, some of which have already been discovered, the Yukon district of Canada will probably become one of the steady producers of gold like California or Colorado. The output this year will probably not greatly exceed £800,000, partly owing to the scarcity of water in the creeks last summer, which interfered with the washing in the creeks. Nevertheless, the Canadian production of gold for 1897 will, with this addition, be raised to over £1,000,000, or considerably above that of 1893, which amounted to £900,000, and is still the highest on record. There is little doubt that this will be largely augmented in the next few years, and that the Yukon district will be the richest Canadian gold field yet discovered.

T. K. ROSE.

PALESTINE EXPLORATION.*

THE object of exploration is to obtain accurate knowledge of a country, its inhabitants and its extant monuments and texts. That of Palestine has special interest to Christian races and to Jews, as serving to explain more clearly the sacred literature of their faith.

The results of such exploration may be judged by looking back a century to the time of Bayle, Voltaire and Astruc, when what was regarded as advanced scientific work assumed that the Hebrews were a savage race without literature, that history only began to be written about 500 B. C., and that the oldest civilization was that of China and India. It is now known that the art of writing was practiced in Egypt and Chaldea as early as 3000 B. C., that the Canaanites, about the time of Joshua, had a civilization equal to that of surrounding nations, as had also the Hebrew kings; while, on the other hand, Chinese civilization is only traceable to about 800 B. C., and that of India was derived from the later Persians, Arabs and Greeks. These results are due solely to exploration.

The requirements for exploration demand a knowledge, not only of Syrian antiquities, but of those of neighboring nations. It is necessary to understand the scripts and languages in use, and to study the original records as well as the art and architecture of various ages and countries. Much of our information is derived from Egyptian and Assyrian records of conquest, as well as from the monuments of Palestine itself. As regards scripts, the earliest alphabetic texts date only from about 900 B. C., but previous to this period we have to deal with the cuneiform, the Egyptian, the Hittite and the Cypriote characters.

The explorer must know the history of the cuneiform from 2700 B. C. down to the Greek and Roman age, and the changes which occurred in the forms of some 550 characters originally hieroglyphics, but finally reduced to a rude alphabet by the Persians, and used not only in Babylonia and Assyria, but also as early as 1500 B. C. in Asia Minor, Syria, Armenia, Palestine and even by special scribes in Egypt. He should also be able to read the various Egyptian scripts—the 400 hieroglyphics of the monuments, the hieratic, or running hand of the papyri, and the later demotic. The Hittite characters are quite distinct, and number at least 130 characters, used in Syria and Asia Minor from 1500 B. C., or earlier, down to about 700 B. C. The study of these characters is in its infancy. The syllabary of Cyprus was a character derived from these Hittite hieroglyphics, and used by the Greeks about 300 B. C. It includes some fifty characters, and was probably the original system whence the Phoenician alphabet was derived. As regards alphabets, the explorer must study the early Phoenician and the Hebrew, Samaritan and Moabite, with the later Aramean branch of this alphabet, whence square Hebrew is derived. He must also know the Ionian alphabet, whence Greek and Roman characters arose, and the early Arab scripts—Palmyrene, Nabathean and Sabean, whence are derived the Syriac, Cufic, Arabic and Himyaritic alphabets.

As regards languages, the scholars of the last century had to deal only with Hebrew, Aramaic, Syriac, Coptic and Greek, but as the result of exploration we now deal with the Ancient Egyptian whence Coptic is derived, and with various languages in cuneiform script, including the Akkadian (resembling pure Turkish) and the allied dialects of Susa, Media, Armenia and of the Hittites; the Assyrian, the earliest and most elaborate of Semitic languages; and Aryan tongues, such as the Persian, the Vannic and the Lycian.

The art and architecture of Western Asia also furnish much information as to religious ideas, customs, dress and history, including inscribed seals and amulets, early coins and gems. The explorer must also study the remains of Greek, Roman, Arab and Crusader periods, in order to distinguish these from the earlier remains of the Canaanites, Phoenicians, Hebrews, Egyptians and Assyrians, as well as the art of the Jews and Gnostics about the Christian era, and the later pagan structures down to the fourth century A. D.

The monuments actually found in Palestine are few, though important. The discovery at Tell el Amarna of about 150 letters written by Phoenicians, Philistines and Amorites—and in one case by a Hittite prince—to the kings of Egypt proves, however, the use of cuneiform on clay tablets by the Syrians as early as 1500 B. C., and one such letter has been recovered in the ruins of Lachish. The oldest monuments referring to Syria and Palestine are found at Tell Loh, on the Lower Euphrates, and date from 2700 B. C. Next to these are the Karnak lists of Thothmes III, about 1600 B. C., recording the names of 119 towns in Palestine, conquered after the defeat of the Hittites at Megiddo. These lists show that the town names which occur in the Bible are mainly Canaanite, and were not of Hebrew origin. The Canaanite language of this period was practically the same as the Assyrian, excepting that of the Hittites, which was akin to the Akkadian.

In the next century the Tell el Amarna tablets show that the Canaanites had walled cities, temples, chariots and a fully developed native art. They record the defeat of the Egyptians in the north by Hittites and Amorites, and the invasion of the south by the Abiri, in whom Drs. Zimmern and Winckler recognize the Hebrews, the period coinciding with the Old Testament date for Joshua's conquest.

An inscription of Mineptah, discovered in 1896, speaks of the Israelites as already inhabiting Palestine about 1200 B. C., and agrees with the preceding. Other Egyptian records refer to the conquests of Rameses II in Galilee and in Syria, when the Hittites retained their independence; and in the time of Rehoboam, Shishak has left a list of his conquests of 133 towns in Palestine, including the names of many towns noticed in the Bible.

The Hittite texts found at Hamath, Carchemish and Merash, as well as in Asia Minor, belonged to temples and accompany sculptures of religious origin. They are still imperfectly understood, but the character of the languages, the Mongol origin of the people, and the equality of their civilization to that of their neighbors, have been established, while their history is recovered from Egyptian and Assyrian notices. The Amorites were a Semitic people akin to the Assyrians, and their language and civilization are known from their own records, while they are represented at Karnak with Semitic features.

The oldest alphabetic text is that of the Moabite stone about 900 B. C., found at Dibon, east of the Dead Sea, on a pillar of basalt, and recording the victories of King Mesha over the Hebrews, as mentioned in the Bible. Several Bible towns are noticed, with the name of King Omri, and the language, through approaching Hebrew very closely, gives us a Moabite dialect akin to the Syrian, which is preserved in texts at Samalia, in the extreme north of Syria, dating from 800 B. C. The Phoenician inscriptions found at Jaffa, Acre, Tyre, Sidon, Gebal and in Cyprus, do not date earlier than 600 B. C., and show us a distinct dialect less like Hebrew than the Moabite. The most important of these early texts is the Siloam inscription in the rock-cut aqueduct above the pool, found by a Jewish boy in 1880. It refers only to the cutting of the aqueduct (in the time of Hezekiah), but it gives us the alphabet of the Hebrews and a language the same as that of Isaiah's contemporary writings. It is the only true Hebrew record yet found on monuments, and confirms the Old Testament account of Hezekiah's work.

The Assyrian records refer to the capture of Damascus by Tiglath Pileser III, in 732 B. C., and of Samaria in 722 B. C., as well as to Sennacherib's attack on Jerusalem in 702 B. C. The latter record witnesses also the civilization of the Hebrews under Hezekiah, whose name occurs as well as those of Jehu, Azariah, Menahem, Ahaz, Pekah and Hosea, who, with Manasseh, gave tribute to Assyrian kings.

About the Christian era Greek texts occur in Palestine, the most important being that of Herod's Temple, at Jerusalem, forbidding strangers to enter, and those of Siah, in Bashan, where also Herod erected a temple to a pagan deity. Such texts are very numerous in Decapolis, where a Greek population appears to have settled in the time of Christ.

The geographical results of exploration are also important for critical purposes. Out of about 500 towns in Palestine noticed in the Old Testament, 400 retain their ancient names, and about 150 of these were unknown before the survey of the country in 1872-82. The result of these discoveries has been to show that the topography of the Bible is accurate, and that the writers must have had an intimate knowledge of the land.

Among the most interesting Old Testament sites may be mentioned Lachish, Debir, Megiddo, Mahanaim, Gezer and Adullam as newly identified; and of New Testament sites, Bethabara, Ænon and Sychar, all noticed in the fourth Gospel.

The existing Hebrew remains are few as compared with Roman, Arab and Norman ruins of later ages. They include tombs, aqueducts and fortress walls, with seals, weights and coins. The most important are the walls of the outer court of Herod's great temple at Jerusalem, with his palace at Herodium, and buildings at Cæsarea and Samaria. The curious semi-Greek palace of Hyrcanus, at Tyrus, in Gilead, dates from 176 B. C. In upper Galilee and east of Jordan there are many rude stone monuments—dolmens and standing stones—probably of Canaanite origin, as are the small bronze and pottery idols found in the ruins of Lachish. Sculptured bass-reliefs are, however, not found in Palestine proper, having been probably destroyed by the Hebrews.

This slight sketch may suffice to show the advance in knowledge due to exploration during the last thirty years. The result has been a great change in educated opinion as to the antiquity of civilization among the Hebrews and Jews, and as to the historic reliability of the Bible records. Further exploration, especially by excavation, may be expected to produce yet more interesting results, and deserves general support, as all classes of thinkers agree in the desirability of increasing actual knowledge of the past. It is no longer possible to regard the Hebrews as an ignorant and savage people, or to consider their sacred writings as belonging necessarily to the later times of subjection under the Persians. Internal criticism is checked and controlled by the results of exploration, and by the recovery of independent historical notices.

We are indebted to Nature for the above particulars.

* A discourse at the Royal Institution by Lieut.-Col. C. R. Conder.

German statistics for 1896 show that there died within the empire, immediately killed by boiler explosions, or within 48 hours of the accident, 30 persons, 2 were badly injured, and 13 slightly hurt. The causes were, in 8 cases insufficient water supply, brought about in 3 of these 8 cases by careless supervision, in 1 case inadequate material, in 2 cases local wear, and 1 case each was due to bad reparation, old fissures, worn material, over pressure, sediment of mud and calcium sulphate.—Uhland's Wochenschrift.

SELECTED FORMULÆ.

Decolorizing or Bleaching Linseed Oil.—Bleached linseed oil may be prepared by everybody without much cost or trouble, says the Neue Deutsche Maler Zeitung, since only a little of it is required at best. If it is to be done by the aid of chemical bodies, the process of oxidizing or bleaching is best performed by means of peroxide of hydrogen, a clear liquid of siruplike consistency. For this purpose, the linseed oil to be bleached is mixed with 5 per cent. peroxide of hydrogen in a tin or glass bottle, and the mixture is shaken well repeatedly. After a few days have elapsed the linseed oil is entirely bleached and clarified, so that it can be poured off from the peroxide of hydrogen, which has been reduced to oxide of hydrogen, i. e., water, by the process of oxidation. The use of another oxidizing medium, such as chloride of lime and hydrochloric acid or bichromate of calcium and sulphuric acid, etc., cannot be recommended to the layman, as the operation requires more care and is not without danger. If there is no hurry about the preparation of bleached linseed oil, sun bleaching seems to be the most recommendable method. For this only a glass bottle is required, or, better still, a flat glass dish, of any shape, which can be covered with a protruding piece of glass. For the admission of air, lay some sticks of wood over the dish and the glass on top. The thinner the layer of linseed oil, the quicker will be the oxidation process. It is, of course, necessary to place the vessel in such a manner that it is exposed to the rays of the sun for many hours daily.

Carbon Paper.—Melt 10 parts lard, 1 part of wax, and mix with a sufficient quantity of fine lampblack. Saturate unglazed paper with this, remove excess and press.

Coloring Gun Barrels.—Bluing Barrels.—The bluing of gun barrels is effected by heating evenly in a muffle until the desired blue color is raised, the barrel being first made clean and bright with emery cloth, leaving no marks of grease or dirt upon the metal when the bluing takes place, and then allow to cool in the air. It requires considerable experience to obtain an even clear blue. Browning Guns.—The following recipe for browning is from the United States Ordnance Manual: Spirits of wine, 1½ ounce; tincture of iron, 1½ ounce; corrosive sublimate, 1½ ounce; sweet spirits of niter, 1½ ounce; blue vitriol, 1 ounce; nitric acid, ¾ ounce. Mix and dissolve in 1 quart of warm water and keep in a glass jar. Clean the barrel well with caustic soda water to remove grease or oil. Then clean the surface of all stains and marks by emery paper or cloth, so as to produce an even, bright surface for the acid to act upon, and one without finger marks. Stop the bore and vent with wooden plugs. Then apply the mixture to every part with a sponge or rag, and expose to the air for twenty-four hours, when the loose rust should be rubbed off with a steel scratch brush. Use the mixture and the scratch brush twice, and more if necessary, and finally wash in boiling water, dry quickly, and wipe with linseed oil or varnish with shellac.

Enamel for Copper Cooking Vessels.—To enamel copper cooking vessels, white fluorspar is ground to a fine powder and strongly calcined with an equal volume of unburnt gypsum, at a light glowing heat, stirring diligently. Then grind the mixture to a paste with water, paint the vessel with it, using a brush, or pour in the paste like a glaze and dry the same. Increase the heat gradually and bring the vessels with the glass substance quickly into strong heat, under a suitable covering or a mantle of burnt clay. The substance soon forms a white, opaque enamel, which adheres firmly to the copper. It can stand pretty hard knocks without cracking, is adapted for cooking purposes and not attacked by acid matters. If the glassy substance is desired to cling well and firmly to the copper, a sudden and severe heat must be observed.

Hektograph Sheets.—Soak 4 parts of best white glue in a mixture of 5 parts of water and 3 parts of solution of ammonia, until the glue is soft. Warm the mixture until the glue is dissolved and add 3 parts of granulated sugar and 8 parts of glycerine, stirring well and letting come to the boiling point. While hot, paint it upon white blotting paper with a broad copying brush, until the paper is thoroughly soaked and a thin coating remains on the surface. Allow it to dry for two or three days and it is then ready for use. An aniline ink should be used for writing, and before transferring to the blotting paper, wet the latter with a damped sponge and allow it to stand one or two minutes. Then proceed to make copies in the ordinary way. If the sheets are laid aside for two days, the old writing sinks in and does not require to be washed off.—Chem. and Drug.

Cigar Flavoring.—

(1) Macerate 2 ounces of cinnamon and 4 ounces of tonka beans, ground fine, in 1 quart of rum.

(2) Moisten ordinary cigars with a strong tincture of cascarilla, to which a little gum benzoin and storax may be added. Some persons add a small quantity of camphor, or oil of cloves or cassia.

(3)

Tincture of valerian	4	drachms.
Butyric aldehyde	4	"
Nitrous ether	1	"
Tincture vanilla	2	"
Alcohol	5	ounces.
Water, enough to make	16	"

(4) The following formula was contributed to an exchange some years ago as one which was put up for cigar manufacturers:

Extract vanilla	4	ounces.
Alcohol, Jamaica rum, } of each	½	gallon.
Tincture valerian	8	ounces.
Caraway seed	2	"
English valerian root	2	"
Bitter orange peel	2	"
Tonka beans	4	drachms.
Myrrh	16	ounces.

Soak the myrrh for three days in 6 quarts of water (?), add the alcohol, tincture valerian and extract of vanilla, and after grinding the other ingredients to a coarse powder, put all together in a jug and macerate for two weeks, occasionally shaking; lastly, strain.—Pharmaceutical Era.

ENGINEERING NOTES.

Charles Parsons, the inventor of the steam turbine which was fitted in the 100 foot torpedo boat Turbinia, giving her a speed of 33 knots an hour, is about to construct at Newcastle-on-Tyne a vessel of the torpedo boat destroyer type with turbine engines. It is stated that she will have a speed of 36 to 40 knots an hour.

What is said to be the largest dredge ever built has lately been put together in Buffalo. It is 140 feet long, 40 feet wide, and 12 feet deep. The fifteen ton clam-shell bucket will operate at a depth of 80 feet, forcing up 10 cubic yards of mud at once. The dredge is named Fin McCool (Finn MacCumhail), who, according to legend, was the strongest Irishman in the world.

For years the St. Gothard tunnel has been famous as the longest in the world, extending nearly nine and a half miles. The glory of this tunnel is about to depart, as the longest tunnel is about to be constructed in England. It is to be on the line of the London and Northwestern Railway Company, which has decided to bore through the steep incline known as Shapfall, with which travelers to Scotland are more or less familiar.

H and W. Pataky, of Berlin, have constructed a simple apparatus for arriving at a comparative idea of the value of a packing or lagging material. It is simply a gas pipe connected with a steam pipe, with valve and manometer. The pipe is provided with a discharge cock at its lower end. The pipe is coated with the material in question, and steam is admitted into it, the cock first being left open. After a while the cock is closed, the pipe is filled with steam, but the valve is not closed. The steam continues to circulate and to condense. The condensed water will finally reach a mark made on a water gage. From the period which has elapsed, the heat conductivity of the material can be estimated.

From some experiments on the pneumatic caissons of the new quays at Bordeaux, M. A. Pasqueau is of the opinion that it is possible for men to work under compressed air at a pressure of about 77 lb. per square inch, which is equivalent to about 170 ft. sea water, but for this depth the pressure should not be reduced at a quicker rate than 10 minutes to about 1½ lb. He also recommends that the chamber in which work is being done should be warmed to from 68 to 86 deg. Fahr.; that the air lock should be supplied with fresh air during the time the pressure is being let down; that no valves controlling air should be manipulated by the workmen; and that in order to lessen fatigue the men should be brought to the surface by mechanical lifts.

A mass of copper and silver ore weighing 3,567 pounds, from the great Anaconda copper mine of Butte, Mont., has been presented by H. B. Parsons, vice-president of the Anaconda Copper Mining Company, to the Museum of the Brooklyn Institute of Arts and Sciences. The big chunk of ore was carted from the office of Wells, Fargo & Company, 63 Broadway, recently, to Brooklyn, a crowd gathering in the street while it was being removed from the express office. The mass contains, per assay, 75·04 per cent. of pure copper and pure silver at the ratio of 50·05 ounces to the ton. The metal in it is worth $375. It is the second largest mass of Anaconda ore ever brought east, one piece weighing 5,000 pounds having been sent to the Chicago World's Fair. Its donor, Mr. Parsons, is a trustee of the Brooklyn Institute.

A New York-Chicago limited train, consisting of seven cars, has just been turned out of the shops of the Wagner Palace Car Company, and will shortly be put in operation by the New York Central & Hudson River Railroad, says Engineering News. The train will make the trip between Chicago and New York in twenty-four hours, and will be known as the New Lake Shore Limited. It consists of a buffet smoking car, a dining car, a drawing room car, three sleeping cars and a compartment observation car. The cars are connected by wide vestibules, and have Pintsch gas ceiling lights and electric berth lights, the electric lighting system adopted being the Gibbs. The baggage room of the buffet smoking car contains the 30 horse power Westinghouse engine and dynamo for electric lighting. The train is luxuriously equipped throughout, having bath, barber shop, library, waiting room, stenographers' and typewriters' service, the latter being free, besides the usual conveniences and comforts of the regular Wagner car service. Perhaps the most distinctive features of the train as a whole are the provisions made for persons or parties designing to travel as privately as possible, there being private state rooms, private dining rooms, etc., with separate wash rooms and toilet conveniences. In the interior the cars exhibit a variety of styles of decoration, but on the outside all are alike, being the regular Wagner palace car color, sparingly decorated with gold leaf.

A plan is being perfected by the navy department for the establishment of a complete system of signal stations along the Atlantic coast, by which ships of the navy passing near the shore may receive messages from and send them to Washington authorities. Such a system has been in operation abroad, and has performed valuable service for the navy. It is intended to use, when practicable, the life saving stations for signal towers, and where such stations are not well located new ones are to be established for the exclusive use of the signal service. A board has been appointed by Secretary Long to report a practicable measure. This board consists of Commander Schoeder, Lieut. Gibbons, Lieut. Harlow, and Lieut. Anderson of the New York Naval Militia, and has been in session several days. Along the Long Island shore, and at other points where the life saving service cannot be utilized for the new scheme, stations will be placed in charge of members of the State militia, which will have entire charge of the system in time of war. Communication from one station to another will be had by telephone and telegraph, so that it will be possible for the movements of a fleet sailing well inshore to be kept in touch with the entire system. It is probable that the government will have a special line of wire to Washington, in order that it may be kept in prompt communication with the signal stations when necessary. For years Great Britain, France, and other European powers have used a like system extensively, and with a chain of life saving stations extending from Maine to Florida it will not be difficult for the navy to apply it here.

ELECTRICAL NOTES.

It has been suggested to use a new unit of length for very great distances, such as those in astronomy, over which an electrical impulse could be sent in one second; it is assumed that in one second a current impulse would travel seven times around the earth. According to this it is stated by an Austrian contemporary, says The Electrical World, that a message could be sent to the moon in one second, while it would take eight minutes to reach the sun. The nearest star would receive a message after four years. There are fixed stars which are still visible which to-day would not have received the news of the discovery of America, while there are still others at which the news of the birth of Christ would not have been received.

In 1869 there were sent in Belgium 1,722,586 commercial telegrams and 315,722 telegrams relating to the service of the telegraph, which required no toll. The receipts amounted to 1,322,000 francs. The Hughes printing telegraph instrument was then adopted, and, with some improvements, is still used. Ten years later multiple telegraphy was adopted upon commercial lines and has since grown so that upon all wires this rapid system is used more or less. A report made at the close of the year 1894 shows for Belgium alone 34,740 kilometers of wire, including the telephone service of 23,236 kilometers. Private line wires in 1895 were 58,078 kilometers. Upon these lines of telegraph there were used 1,806 instruments, employing 8,739 people.

It has long been held from practical experience that the network of wires now found in many towns protects those places from the effects of lightning, and probably also prevents many thunderstorms from breaking over them. An official inquiry has been recently made in Germany as to the influence exerted by telephone wires on atmospheric electricity, with a view to set at rest the question whether danger from lightning stroke is increased or diminished by a close network of wires. The inquiry has shown that the wires tend to weaken the violence and diminish the danger of lightning stroke. Returns obtained from three hundred and forty towns provided, and from five hundred and sixty not provided with a telephone system, show that the danger varies in the proportion of 1 to 4·6 between the two cases.—Invention.

A table taken from the annual reports of the Railroad Commissioners of New York and Massachusetts for nearly all of the street railway properties shows the cost of the electric power required to run a car one mile under average conditions of load, etc. The table gives, says The Street Railway Journal, the number of cars owned, the car mileage per year and the cost of the electric power per mile and per passenger. Of the nineteen companies operating less than two hundred and fifty thousand car miles, four are obtaining power at a cost of less than 2 cents per car, six between 2 and 3 cents, five between 3 and 4 cents, one between 4 and 5 cents, and three at more than 5 cents; of the five companies operating over five million car miles per year, one obtains the power at less than 1 cent per car mile, three between 1 and 2 cents, and one between 2 and 3 cents; other similar figures are also given between these limits. The Brooklyn Heights Company has the cheapest power, 0·86 per car mile, followed by the Binghamton, with 0·94; the cost of power for Massachusetts roads includes repairs and depreciation of the station plant, which is not the case of the New York roads.

The chief idea underlying the proposal which Bochet has made to the Société Internationale des Electriciens is not strikingly novel, and all will depend upon the details of his device. We remember several patents concerning contacts exposed at the height of the cars for long conductor strips fixed on one side of the top of the cars in such a way that the conductor is always in contact with one of the terminals. Le Génie Civil, which reports upon Bochet's paper, illustrates one of his proposals, which fixes the contacts to short brackets attached to the lamp posts. Two cars are shown joined in order to get a greater length for the conductor above. That will not always be possible, and to place poles at distances of less than the length of an ordinary train car apart does not look very hopeful either. There must be considerable difficulties in carrying out projects of such apparent simplicity. Otherwise the trolley would have had to go, for the objections to the trolley remain strong. In some parts of Berlin, where the buzzing aerial conductors were not to be tolerated, short conduit sections have been tried during the last months. But all sorts of things, as we see from a paper by Fischer-Dick, in Glaser's Annalen, children's iron hoops among them, got into the slot, and the contact plows showed the severe wear very distinctly.

A very clever mail delivery box has been placed in a number of the larger buildings at Geneva, Switzerland, by an enterprising electrician, says The Electrical Engineer. This mail box has a compartment for each of the stories of the building, and when the letters are deposited on the ground floor the carrier delivers them as required. The deposit of a single letter makes an electric contact, which starts a bell going on the respective floor, which does not cease ringing until the letter is taken out. At the same time it opens the faucet of a tank on the roof of the house, which causes water to flow into the cylinder forming the counterweight of the mail box elevator until the weight is heavier than the box, when the box ascends and the flow of water ceases simultaneously. As the box passes each story, the mail intended for it—letters, papers and small packages—falls into boxes in the corridor on that floor. This is performed very reliably by a little spring at the bottom of each compartment in the elevator mail box, which causes the bottom of the compartment to catch for a moment, and the release throws out even a single piece of paper thinner than a postal card into the stationary box provided for its reception. When the box has passed the uppermost floor, the cylinder filled with water strikes a bolt provided at the bottom, which allows the water to flow out, and by its own weight the box descends to its place on the ground floor. Should by any mischance a single piece of paper have remained in the elevator, upon striking the bottom it will at once go through the same series of movements as before.

MISCELLANEOUS NOTES.

Over 140,000 persons traveled through Switzerland in government post chaises and diligences last year. Of these 77,736 went into the Engadine by the Schyn Julier, Albula, Fluela, and Bernina passes; 14,616 were transported over the Ober Alp; 14,173 over the Splugen; 8,676 over the Bernardin; and 7,502 over the Simplon.

A publication has been issued by William T. Lewis, president of the Philadelphia Horological Society, on the lubrication of watches, chronometers and clocks. In these few pages he emphasizes the fact, among others, that even the best made watch cannot keep accurate time from year to year unless lubricated with the finest quality of oil. Among the sources of lubricants for this purpose mention is made of porpoise jaw oil and blackfish "melon" oil as having become widely and justly celebrated in all parts of the world for lubricating fine and delicate machinery. The blackfish melon oil derives its name from the mass from which it is extracted, taken from the top of the head of the blackfish, reaching from the spout hole to the end of the nose and from the top of the head down to the upper jaw.

According to a recent paper by Mr. Corbet Woodall, the cost of carbureted water gas in England is determined chiefly by the price at which oil can be bought. The sources of supply are the wells of Russia and America, and also, though to a small extent only, the shale oil works of Scotland. At present suitable oil can be purchased at 5 cents per gallon at English ports, which represents about 5·5 cents at the average gas works. Gas of an illuminating value of 20 candles will require 3 gallons of oil per 1,000 cubic feet, and 40 pounds of coke will also be used in making that quantity. The cost of making gas of 20 candle power, with oil at 5·5 cents per gallon and coke at $3.00 per ton, will be 32 cents per 1,000 feet in the gasholders. This is about the same as the current average cost of making coal gas of 15 candles.

In a recent lecture by Prof. A. H. Sabin in Brooklyn, N. Y., on the corrosion of iron and steel, the fact was noted of iron lying in the ground 1,000 years and being dug up in a fairly well preserved condition; while, on the other hand, modern water pipes which have been underground only a few years have been found badly rust eaten, and in Boston recently a thick cast iron water pipe was taken up and sections of it had corrosive holes from the size of a walnut to that of an apple. Still further, this contrast between the former and later periods is seen in the fact that even in structures exposed but to the action of the air, the steel has been seen to decay in a comparatively short time, and steel beams have had to be frequently removed from buildings. Once the work of corrosion sets in, the progress of chemical decline is quick.

Cheap houses for workmen are being built in Leipsic by "The Society for Building Cheap Houses for Workmen." This society has already built 30 houses, valued at $387,216, and providing 361 lodgings for families and 38 for single persons. As the society only demands 3 per cent. returns on its capital, it rents houses on the following terms: Single rooms, $9.50 to $14.25 per annum; apartments of three rooms, from $31 to $38, and of four rooms, $36 to $47. A small garden costs 4 cents per week additional, and for 5 cents per day a child will be cared for, including its meals. Rent is payable weekly, and the deficit caused by delayed payments amounts to only 6 per cent. on the total receipts. No tenant is allowed to sublet rooms, and the proprietor must give a week's notice and the rentor three months' notice before changing.

We do not know that the town of Ludwigshafen, situated opposite Mannheim on the Rhine, has particularly suffered from fires, but we see that they have ordered a skeleton house with three rows of windows for fire brigade practice, and also for drying the fire hose. The iron structure consists of a ground floor in corrugated iron, and three stories of open angle iron work, rising to a height of 48 feet, and further overtopped by an iron pipe, 27 inches wide, extending to a height of 71 feet. This iron pipe, in which the hose is to be dried, does not reach down to the ground. The whole structure is to be fixed to any foundation, and can easily be taken to pieces and transported. Ludwigshafen is quite a modern industrial town. In 1840 not 100 souls were living on the spot; at present the many and varied works give employment to almost 40,000 people. The structure, which has three windows in each row, front and back, and two in each on the sides, is being built by W. Martin, of Marten, Westphalia. The order is somewhat unusual for a small town.

According to one writer of the modern school, the best way to dispose of broken china is a method that is not quite new, but one that is being revived. The result is almost pretty enough to console a housewife for the loss of her cherished china. This means of disposition requires a large number of broken pieces, the more and the smaller they are the better. The only accessories needed in the process of saving broken china are plentiful supplies of putty, a smooth surface like a board or a flower jar, and a bottle of gilding. There are two methods of procedure. One is to cover the board or jar with putty and pat it down smooth and even before beginning to stick on the broken pieces. This method is preferable if one has enough pieces to finish the whole surface at one sitting. If not, it is better to take a small lump of putty for each piece, fitting it down and putting the next one into place beside it, and so on until the surface is covered. The putty which oozes up between the pieces is then gilded, and the process, so far as the broken pieces are concerned, is over. So far, only the bare material for articles of use has been manufactured, but there is no end to the list of uses to which it may be put. Some women use it for picture frames, others for imitation tiling or mosaic. If one has a large supply of broken dishes, an ugly mantelshelf can be greatly beautified in this manner. It would require the savings of several families for this, however, and unless the mantel is very small, it is rather too ambitious an undertaking for a beginner. It may be mentioned that if putty is used for the purpose above indicated, it might be an improvement to adulterate it largely with white lead, as used by our grandmothers, and a still greater improvement might be to use plaster of Paris tempered with whiting.

GRAIN ELEVATOR IN COPENHAGEN.

The imposing grain elevators and stores that have recently been erected in European seaports prove that the greatest attention is given, not only in the United States but also in Europe, to arrangements and apparatus relating to the storing of grain and to this branch of commerce, and as we think it may be of interest to some of our readers to see just how a building devoted to such purposes is arranged, we publish herewith engravings giving the elevation and cross section of the grain elevator of the Kjöbenhavns Frihavns Aktieselskab in Copenhagen. It stands on the end of a pier 187 ft. wide; the quays on each side are about 43 ft. wide and each of them is provided with railroad tracks that are connected at the ends by turn tables and cross tracks.

A tunnel runs along the quay which is designed for the reception of pipes, electric cables, etc., and into this tunnel six cross tunnels open on each side, which contain twelve carrier belts that can be loaded from

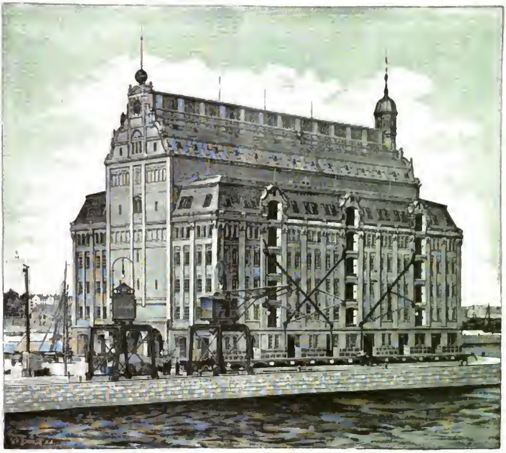


Fig. 1.—GRAIN STOREHOUSE AND ELEVATOR IN COPENHAGEN.

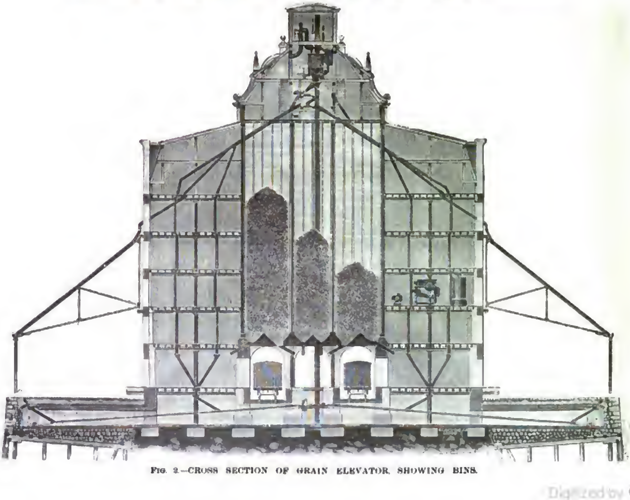


Fig. 2.—CROSS SECTION OF GRAIN ELEVATOR, SHOWING BINS.

openings in the main tunnel when the iron covering is removed.

The building is 170 ft. 7 in. long, 108 ft. 4 in. broad, 42 ft. 7 in. of which breadth is taken up by the bins, and 128 ft. high from the cellar floor to the roof. The bins, thirty-six in number, have a height of 65 ft. 7 in., a length of 15 ft. and a breadth of 12 ft. 5 in., and each one holds two hundred tons. The funnel-shaped floors are made of beton laid between I beams and rest on wrought iron pillars. At each center there is a pressure of 900,000 lb. The walls of the bins are made of boards secured to standards, only the outer walls of the two groups, each of which consists of eighteen bins, being fireproof. The rooms of the different stories, or lofts, are provided with double floors with a filling of sheets of asbestos on wooden beams, iron beams and pillars.

The elevators designed for unloading the grain from vessels have not yet been built, and so for the present it is raised by means of the hoisting devices of the vessel, which throw it into tubes that conduct it to the carrier belts. These belts consist of impregnated hemp, are 23½ in. wide, and with a speed of 6 ft. 6 in. can carry sixty to seventy tons per hour. As shown in Fig. 2, two belts work on one elevator, but only one at a time, of course, one being always cut out. The grain carried in by the belts is raised by elevators 131 ft. long, which have a velocity of 28 ft. and are capable of raising sixty to seventy tons per hour. They are provided with patent buckets 8½ in. wide and 4½ in. high. The lower part of the elevator is provided with tension devices; the upper part is made of iron, and the shafts of the elevator drums and the gearing rest on iron bearings. The wheels have a proportion of 1:4, so that the gearing makes 160 revolutions to 40 of the elevator shafts. The teeth of the wheels are cut. The further transmission to the electric motors is accomplished by means of belts. The space devoted to the machinery is fireproof and elegantly finished.

From the elevators the grain passes on two box scales, each of which weighs one ton at a time. One man takes charge of two scales. While one is being filled the other is tared and emptied by means of a lever on the box; then, by means of a second lever, the supply is admitted to the other box and this one is tared. Sixty boxes are weighed per hour; that is, one per minute. In order to avoid the terrible dust which arises when some kinds of grain are weighed, the scale holders are uncovered and air is sucked through the small opening, whereby the escape of the dust is prevented.

The weighed grain falls into a revoluble funnel or hopper, which conducts it to the next story or bin, or, if it is to be stored at a greater distance from the scales, it is conducted to the proper belt, which carries it to the desired place. Each belt has two deflectors which direct the grain to the right or left in the tubes or to the belt again. These deflectors are moved mechanically by chains, the movement of which is regulated by a pull on the guide rope. By means of this arrangement and the conducting tubes on the different stories the work is carried on; the grain is unloaded from the vessels, weighed, and stored in the desired bin or floor of the building. A similar arrangement serves for circulating the grain and loading the vessels.

If the grain is to be loaded on a vessel, the adjustable loading tubes are set in operation, and these, with the vertical hanging tubes, deliver the grain directly to the hold of the vessel. If this is to be reversed, the next tube is opened by turning a funnel-shaped head. At first the grain runs by its own weight through the tubes on the particular carrier belt and elevator, but later it is necessary to shovel it. When it is discharged from the elevator, it is subjected to a current of air which blows off the fine dust and chaff; then it passes through the adjustable funnels and the proper tubes, back to the desired floor. It is evident that the effect obtained by this ventilation is quite different from that obtained by the old hand turning on the different floors.

A cleaning machine is provided for the thorough cleaning and separation of the coarser parts.

All of these machines are driven by electricity from the central harbor station, which furnishes 100 horse power, driving five primary dynamos at 450 volts. The distribution of the electric energy is accomplished by means of the triple conductor system at 2 × 250 volts. In the bins there are six electric motors of 15 horse power, for operating the elevators, one for the upper carrier belts and the exhauster, two in the cellar for operating the belts there, and one for the cleaning machine; ten in all. There are also two electric hoisting devices with two direct coupled 20 horse power motors. These raise one ton 1 ft. 7 in. per second.

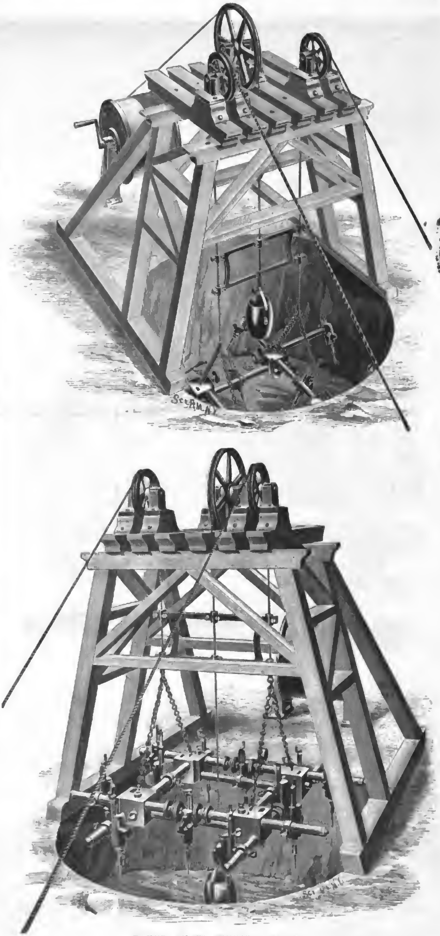
The electric driving devices, which are here used on a larger scale than ever before, have proved excellent. The fact that they are always ready for use and that they do away with the heavy transmission bands or ropes which are usually carried to the upper stories render this superior to all other methods.—Oesterreichische Monatsschrift für den Oeffentlichen Baudienst.

McCULLOCH'S FRAME [illegible]ING ROUND SHAFTS.

THE sinking of a roun[illegible] present known appliances, is a far mor[illegible]ration than the sinking of a rectangular [illegible] rectangular shaft, varying from 7 ft. to 8 f[illegible]ar of that length, fixed to the sides of th[illegible] retain its rigidity sufficiently when the [illegible] operation; but in a round shaft, where a f[illegible] to be the whole span of the shaft's diamete[illegible] too great to secure the rigidity of the ba[illegible]rills are in operation; hence tripods and [illegible] have to be used, which are ineffective [illegible]rk, and entail a maximum amount of lab[illegible] with a minimum result in the speed of [illegible]Culloch's shaft-sinking frame is so design[illegible] bars on which the drills are operated sha[illegible] rigid, removing at once all difficulties c[illegible]h the sinking of round shafts, and enab[illegible] be sunk with an economy in working and [illegible] in sinking never yet attained.

Seeing, then [illegible]orking on mounted bars or tripods canno[illegible]ective duty as they would if fixed on perf[illegible] bars, it necessarily follows that to attain a maximum speed in sinking: (1) The drills, to give their full duty, should work on a perfectly rigid bar or bars, and that these bars should be arranged so as to get as large a number of drills as possible working in the shaft simultaneously. (2) That they should be placed and adjusted on the bars so as to pitch the blasting holes in the shaft in the most advantageous positions, in order that the maximum result may be obtained when blasting. (3) That after the boring of the floor of the shaft is completed, the whole of the frame and boring plant shall be removed expeditiously and easily out of reach of the blasting.

The inventor claims that he has secured all these essential advantages in this sinking frame. (1) The drills, when in the act of boring, will give out their full effective duty, as the bars on which they are fixed

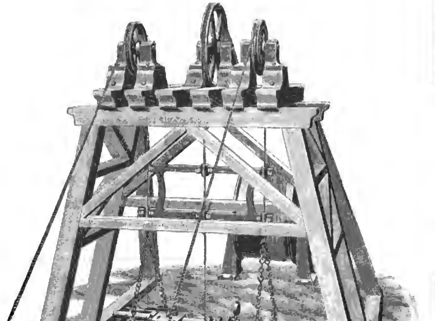


ROUND SHAFT SINKING FRAME.

remain perfectly rigid against the circumference of the shaft, and the frame is designed to carry twelve or any less number of drills, of which all or any number desired can be worked simultaneously. (2) The drills can be so placed and adjusted on the bars that they will command any part of the shaft, and with ease. (3) And lastly, the whole of the frame, with the drills still fixed on the bars and other tackle, can be hoisted in one operation out of the reach of the blasting, and it is so arranged that the hauling to surface of the broken rock passes through the center of the frame; it is, therefore, not necessary to hoist the frame to the surface, but only so far as will remove it out of reach of damage in blasting.

The inventor also claims other advantages in the use of this sinking frame. It will serve as a template or guide in the sinking of a shaft. It can be utilized as a scaffold for the bricking up of a shaft. It can be used as well for the examination or fixing of the pump or gear work of a shaft.

The frame is suspended from a poppet head with hoisting gear both for the frame and kibble. It is lowered by two ropes working from the poppet head of the shaft, and is attached to the crossheads of the frame, and these ropes pass through a guide. The kibble rope also passes through the same guide, thus preventing the kibble from swaying, and avoiding as well any possible entanglement with the frame ropes.



ROUND SHAFT SINKING FRAME.

The frame is built up of hollow steel tubes—twelve in all—on which twelve or any less number of clamps are placed. The center of the frame is a square of four fixed bars, held together by four strong crossheads. The movable bars—eight in number—pass through these crossheads, at right angles to the fixed bars or framing, and are moved quickly to the circumference of the shaft by a rack and pinion. The cone parts of each bar are then screwed up against the shaft by a screw operated at the back end of the bars, and which moves within the bars or tubes. The importance of this arrangement is very great. It enables the frame to be tightened up against the shaft when the drills are in actual operation, and not in any way altering their position, or the holes that are being bored. It is also automatic in its movement, for whenever the frame is loosened—through the jar and vibration of the drills, or from any other cause—the lever and weight attached to each screw of the bar has a tendency to tighten the frame against the shaft's circumference. The movable bars are all held tightly and firmly in position by set screws and pads. The frame has only to be lowered to the required distance from the floor of the shaft, tightened against the circumference, and it is at once ready for work.

This frame is shown by the Tuckingmill Foundry Company, at the exhibition of the Royal Cornwall Polytechnic Society, Falmouth and Camborne. We are indebted to The London Engineer for the cuts and particulars.

CHINA AND HER RAILWAYS.

ONE of the greatest paradoxes ever presented to the world in connection with the material advancement of a nation is afforded by China. Boasting of a civilization of remote antiquity, claiming to have invented the mariner's compass, gunpowder, and the art of printing, and priding herself upon the initiation of numerous other attributes of modern civilization, she persistently lags behind in all things most essential to national progress. This is particularly noticeable as regards railways. With the motheaten mantle of a long past age descending upon the shoulders of her rulers, generation after generation, they still hold the doctrine that China is the hereditary fountain of all knowledge and advancement, and that any suggestions coming from the West must be, in the nature of things, either retrogressive or only prompted by sinister motives. When by force of circumstances, and owing to external influences, China has been persuaded into taking a step in advance, she has afterward repented of her wisdom, and has willfully demolished in a day the fabric that cost her years to rear. This was the attitude she assumed twenty years since with regard to the Shanghai-Woosung Railway, which was the first line ever constructed in China. It was regarded as a barbarian innovation, and no sooner had the ten miles of railway been built, equipped, started and begun to pay, than the whole line was dismantled and torn up, its stations and other buildings razed to the ground, and some of the constructive materials thrown into the river. It was opened in 1876 and wrecked in the following year. Curiously enough, the Chinese have a proverb that "true wisdom lies not in servile imitation of the past, but in availing one's self of such improvement as experience may have suggested." Pregnant words, full of wisdom to Chinamen in theory, but worse than a dead letter to them in practice.

The reason of this condition of things is not far to seek. It commences with the early education of Chinese officials, and finishes with their effete and corrupt administration when in office. Their utter impotency is a natural result of their education, and they are dominated by the mendacious traditions of their office, which traditions are their lawful and recognized heritage. Not only does their education not fit them for the practical work of government, but by its theoretical and purely academic character it absolutely unfits them for it. Not but what the Chinese educational system is a model of completeness, but it lacks practical backbone. In the mere matter of administration it would form a model for western nations, and yet in itself it constitutes the greatest obstacle to progress. Every youth in the empire is at liberty to compete for the honors awarded to scholarship, and by a process of sifting the candidates are reduced to a very few. The most successful of these, subject only to certain conditions of birth, are eventually installed in the highest government posts. Thus it may be said that the principle of competitive examination is carried to its logical issue, the community being governed by its most learned members. But, unfortunately, the educational system deals only with the lore of the past, modern thought is not only neglected, but regarded with reprobation and contempt. Western ideas, where they differ from those of Confucius, are only regarded as the eccentricities of barbarians. With rulers imbued with notions such as these, it is not to be wondered at that China has never evinced a genuine desire to identify herself with other nations in the cause of material progress.

So far we have indulged more or less in generalities. Let us now enter a little into detail respecting commercial enterprise in China in the past, and so justify our animadversions. For our present purpose three illustrations will suffice, namely, the introduction into China of cotton mills, the electric light and railways. Some twenty years ago a native company was formed for the purpose of establishing a cotton factory in Shanghai. Want of funds retarded the erection of the mills, and after about six years the matter was taken up by another company, partly native and partly foreign, but under the auspices of an American mercantile firm. Steps were quickly taken to have the representative of the American firm secretly arrested upon a trumped up charge and deported to Nankin. The conspiracy, however, was so transparent that the American consul refused to countersign the warrant, and so the matter fell through. The action of the officials, however it may have been prompted, in attempting thus to strangle a foreign innovation, is deserving of the severest reprobation. Nor were the proceedings as regards the introduction of the electric light less worthy of condemnation. A company commenced operations in Shanghai some twelve years since, and the natives readily introduced the new light into various theaters and public saloons within the radius of the concession. No sooner was the enterprise fairly started than the local authorities forbade the use of the electric light by all Chinese, and at the same time the foreign consuls were requested to order the municipal council to remove all the electric lamps in the public streets on account of their mysterious and dangerous nature. The consuls had little trouble in giving a suitable reply to the latter request, but the natives in the foreign settlement, who are, of course, civilly and criminally responsible to their own authorities, had no alternative but to submit.

The opposition to the introduction of railways into China, more especially trunk lines, has proceeded not so much from any aversion to the innovation on the part of the people as to the fact that the officials throughout the empire recognize the danger thereby threatened to the system of illegal taxation on which they thrive. This fact has not been sufficiently realized by the advocates of the introduction of this system of locomotion. Let us briefly trace the history of this advocacy and its results. It is now about forty years since steamboats were successfully introduced into Chinese waters. Some ten years later the late Sir R. Macdonald Stephenson, who had already done so much for the development of railways in India, visited China on a similar mission. The people enthusiastically welcomed him, and his advocacy apparently broke down the last flimsy thread of native prejudice. But Sir R. Macdonald had to reckon with other than the people before he could lay his foundations for the enterprise. The local rulers were up in arms, and raised a general opposition to railways, fearing, as we have pointed out, that they would interfere with their privileges in turning their local taxing powers to the best account. A contributor to this result was probably the very completeness of the scheme which Sir R. Macdonald placed before the authorities. Had he confined himself to a short trial line, he might have been successful in driving in the thin end of the wedge. But fresh from his Indian victories, his scheme embraced the bringing of Calcutta into railway communication with Peking. Hence his motives were either misunderstood or only regarded with suspicion, and so railways in China were not yet to be.

But the idea was not given up. Hope springs eternal in the English contractor's breast, and so it came to pass that, after a time, it occurred to those interested in the matter that the construction of a short line at one of the ports amenable to European influence might form the basis of some extended operations subsequently. Hence the Shanghai-Woosung Railway, the history of which enterprise is not without interest nor its fate without a lesson. In 1865 a company was formed for constructing a line on this route, by which means the changeable and difficult navigation of the river between those two points would be superseded. At the bottom of this scheme were Messrs. Jardine Matheson & Company, who were ever consistent supporters of the various efforts to introduce railways into China. They came to the conclusion that the only feasible plan was to acquire the land and construct the line themselves. The acquisition was a tedious, difficult and costly process, but it was eventually accomplished and a survey of the line was made by Prof. Henry Robinson, C.E., who was appointed engineer of the line. But Messrs. Matheson were not the only persons who had cast longing eyes on China as a field for railway operations. Independently of that firm, and in entire ignorance of their proceedings, the late Mr. Richard C. Rapier, of the firm of Ransomes & Rapier, of Ipswich, had given his attention to the problem, and he conceived that the best way of making a start toward its solution was to send a short length of line—rails, engines and carriages—to the Emperor of China as a present upon the occasion of his majority and marriage. He thought that if the Emperor once experienced the pleasures of a short railway trip, he would certainly desire an extension of his ride. In 1873 the idea began to take definite shape, the late Duke of Sutherland being the first to associate himself with the project. The King of the Belgians subsequently took an active interest in the scheme, and the writer was with Mr. Rapier in Brussels when the project was placed before his Majesty. The movement was at first well supported in diplomatic circles both in this country and in Belgium, but as this course of procedure was ultimately found to be impolitic, the idea was abandoned.

Mr. Rapier, however, still nursed his long-cherished idea, and did not despair of introducing the railway

system into China. He therefore built a small engine weighing only 22 cwt., and Mr. John Dixon, the well-known contractor, who interested himself in the matter, provided about half a mile of light rails and fastenings, ready to be sent to China with the engine, should opportunity arise. In the meantime, Messrs. Matheson's line was being made, and a coalition of all parties interested was brought about. The idea, then, was to send out the rails and engine, and, so far, equip the Matheson line. But its construction had not been completed, and, what was worse, the allotted funds were nearly exhausted. The railway company had only £30,000 left, which was insufficient to carry out the line. At this juncture Mr. Dixon threw himself into the breach, and liberally undertook to complete the line for £20,000—the balance of the company's capital—and £8,000 in shares. He faithfully carried out his contract; the line was made and equipped, and was opened amid public rejoicings on July 1, 1876. But at one o'clock on October 20, 1877, the last train was run from either end, the line being directly afterward ruthlessly dismantled, having been purchased by the Chinese authorities for that purpose. Portions of the rolling stock and plant were sent to Formosa, the remainder being thrown into the Yang-tse.

Such was the fate of the first railway in China. In recent years, however, owing to native influence, the effort to introduce this system of transport into the country has proved more successful. Witness the Shanhaikwan-Tien-Tsin line with its extension to Peking; and if all goes well, far greater extensions will be witnessed, and railways will yet encircle the Celestial Empire. The Chinese are not wholly a nation of imbeciles. There are men of thought, of astuteness and of business ability among them. Of such is Shêng Ta-jên, whose antecedents, however, judged by European standards, are probably less immaculate than those of most Chinese mandarins. No matter, he has satisfied the Emperor of his intelligence, and climbed into power on the shoulders of Li Hung Chang. He was appointed director-general of railways about a year ago, and he quickly succeeded in obtaining an imperial edict for incorporating the Shanhaikwan Railway, with his proposed great trunk line from Peking to Hankow, which will be about 900 miles in length, and which presents some engineering difficulties. This is a big order even for Shêng Ta-jên, who controls the Chinese telegraph system and the great iron works at Han-Yang, besides which he is a director of the China Merchants' Company and the founder of the new Imperial Bank of China. At the same time it was reported some three months since that a Belgian syndicate had successfully negotiated a contract with the Chinese government for the construction of the Hankow line.

In the meantime Shêng wisely purposes commencing with schemes of lesser magnitude, such as lines connecting Woosung, Shanghai, Hangchau, Soochau and Chingkiang. This route lies through a wealthy and populous district, and presents no constructive difficulties, the total length being about 200 miles. The Shanghai-Woosung line was the first to be tackled, and is in course of construction. It practically follows the route of its ill fated predecessor, and is to be laid on the English 4 ft. 8½ in. gage, which gage has been adopted for all the imperial Chinese lines. It is a purely native undertaking, and the rails are to be supplied by the government iron and steel works at Han-Yang, while the carriages are being built at the government works at Tien Tsin. The sleepers are to be supplied from America, Messrs. S. C. Farnham & Company having secured the contract. The locomotives will be built in the same country by the American Trading Company, the present contract being for three tank engines. The iron bridges have been ordered from Germany and the switches from Belgium. England, the pioneer of railways in China, supplies nothing. Such is the irony of fate. There is, however, a chance yet, provided our labor troubles cease and trade gets reorganized in time. A fair start having thus been made under favorable auspices, it is not inconceivable that a very considerable railway system will eventually be developed in China.—Perry F. Nursey in Industries and Iron.

ANCIENT CLOCK BELLS.

In the representations of the clocks of the end of the fifteenth and of the whole of the sixteenth century we find peculiar arrangements of external bells. We shall explain these, because they are now unknown, the original clocks having disappeared or become disfigured.

In the clocks of those times the hammers were very large and were mounted upon long levers provided with a tail or prolongation from which frequently depended a wire. It would seem as if this pulling arrangement were a reminiscence of belfry clocks, in which the watchman had to supply the blows that the wheelwork frequently failed to strike; but the case is not the same, and we cannot very well conceive of the owner of a clock striking the incomplete hour himself. In the various representations of the clocks which we have studied we shall find an explanation of these functions.

The owner of a clock, having a bell within reach of his hand, must necessarily have conceived the idea of using it to call up his servants. All that was to be done was to find a hammer arrangement and the proper length of wire. It was, upon the whole, an intimate application of the striking work of belfry clocks, the tolling of the bell of which served formerly, as it does still, to give alarms. We find an example of this call bell in an engraving of a book by Crispin de Passe, entitled Parabole des Vierges, in the National Library of Paris (Fig. 5). This engraving represents a clock upon the top of which there is placed, crosswise, a hammer that is entirely independent of the clock and that must have served for striking the bell. The two functions of call bell and time bell united in the same clock are very clearly shown in an engraving of the sixteenth century found in the Livre des Bons Engins preserved in the National Library (Fig. 4). In fact, we here see, on one side, the isolated hammer with its lever, and, on the other, the hammer that is directly actuated by the wheelwork of the striking train. There is, therefore, no doubt as to what each of them was designed for.

An engraving by Jean Cousin, entitled Fortune, Amour, Temps (Fig. 1), shows us, in a clock held by a female symbolizing Fortune, a bell surmounted by a single hammer with a lever from the extremity of which hangs a wire. This clock has the weights and counterpoises of the movement and striking train, and this conclusively shows that it must have struck the hours in running concurrently with the call bell, or in silence. At the extremity of the wire, in fact, there is a ring which it sufficed to connect with a detent placed in the interior of the movement (as in the clock shown in Fig. 3) in order to have the clock strike the hours, while, when the wire was detached, the clock became silent.

The object, therefore, was to obtain silence when it was deemed advisable; and to effect this was worth while, since, as we have already remarked, these striking arrangements were very powerful, both by the size of the bell and that of the hammer. It must, therefore, have been the desire of the owner of such clocks not to be compelled, under any circumstances, to listen to their often exaggerated noise. There are, moreover, in our own day, clocks that run in silence.

As soon as the striking train of clocks was devised, there was very naturally an effort made to render it interesting, and so its motive power was soon utilized for actuating chimes concurrently with the simple time bell. Therefore, by the side of the ringer of chimes, who from all times had played with more or less talent, the clock repeated the airs of its cylinder automatically. The chimes of belfry clocks and those of house clocks date from the middle ages. The clocks of these remote epochs have nearly all disappeared. The wheel work, worn out by long service, has been suppressed or replaced, and the simple airs of olden times have been changed. One of these airs, dating from the fifteenth century, and which has come down to us, is that of Vendome, which comprised words that were modified according to the locality. The most celebrated chimes were those of Flanders.

There were belfry clock chimes that possessed a decorative character, in the sense that they were sounded by "jacks of the clock" that struck the bells in turn. Such was the clock of Liege. Others were distinguished by the splendor of their wheelwork (Fig. 2); but, in reality, the chimes derived their effects exclusively from the variety and purity of tone of their bells.

Although house clocks also had chimes as long ago as the fifteenth century, it was especially in the sixteenth that they came more and more into use. The bells were so placed in the campaniles as to be visible, or else were concealed in the interior of the frame.

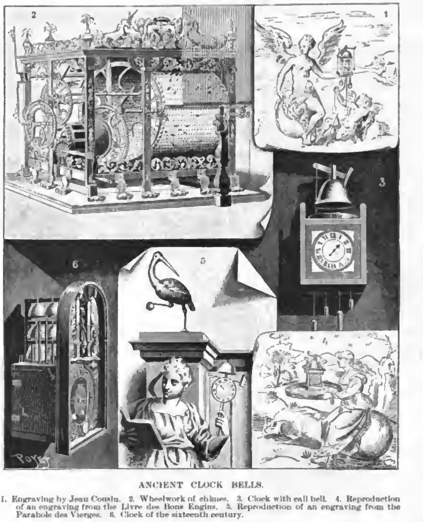
In our collection there is a wooden clock of the end of the sixteenth century which, for its chimes, has six perfectly tuned glass bells, which are fixed in a wooden frame at the top (Fig. 6).

The Louis XIV and Louis XV clocks, which were suspended from the wall, had chimes which were placed either in the case or in the support. In the time of Louis XVI mantel clocks also were provided with them.

In addition to chimes, there were other musical arrangements. Everyone is acquainted with the music produced by the steel comb, which has not changed since the eighteenth century, and everyone has seen music boxes. But dulcimers are not so well known. These are string instruments, like pianos, and the keys of which are actuated by cylinders provided with pins. They have scarcely been applied except in large center-pieces for rooms. The organ stops of clocks and the harmoniflutes have the same system of bellows and pipes as the large church organs and recall the primitive portable organs of the middle ages.

In finishing this brief notice of the curious arrangements introduced into the striking works of clocks, we must not forget the ancient cock and the eternal cuckoo, which, after flapping their wings and opening their bills, sing as many times as there are hours to be indicated. They made their appearance in the middle ages and have been manufactured ever since.

There is still another time-announcing device to be mentioned, and, although it marks the last step in the progress made in this direction, it is not the best. We refer to the phonograph. As for us, we prefer the merry chimes of the days of yore to the voice that announces the hour after the manner of the undertaker's assistant when he calls out that the funeral procession is waiting.—La Nature.



ANCIENT CLOCK BELLS.

1. Engraving by Jean Cousin. 2. Wheelwork of chimes. 3. Clock with call bell. 4. Reproduction of an engraving from the Livre des Bons Engins. 5. Reproduction of an engraving from the Parabole des Vierges. 6. Clock of the sixteenth century.

ELECTRIC RAILWAY DEVELOPMENT AT HOME AND ABROAD.

English contractors (Dick, Kerr & Company, of London) have secured the order for the electrical equipment of the street railway systems of Madrid and Barcelona, Spain, but the subcontract for the generators and full station equipment has been placed with the General Electric Company, of Schenectady. The Railway World, of London, states that 100 motor equipments will be required for these lines and that the full amount of the original contract is about $800,000. The following extract from a press dispatch from Schenectady, dated September 26, is an interesting comment on the use of American electrical machinery:

"While Lord Kelvin was in the act of gratifying his intense curiosity about the General Electric works here, news came of the closing in New York of further contracts, employing English capital, for large electric railway systems in Dublin, Madrid and Barcelona. The amount involved is said to reach £300,000. Lord Kelvin was asked his views on this matter. He said: 'I do not consider it out of the way or surprising that these orders should be placed here. England has not yet developed her electric railway work to as large an extent as you have, and hence is buying, as she always does, in the best market to save money. She has the engineering and manufacturing talent, but lacks the opportunity. Here you have towns of 10,000 population springing up in a year, and they naturally want the latest and best, making a good demand, which renders easy production on a large scale and also stimulates the older communities near them. We have no

such developments in England, and the areas of our towns are smaller, so that the necessity of city transportation is not so keenly felt as with you.'"

The same state of affairs was recently considered by The Electrical Engineer, of London, and the remarks of that journal are interesting as showing the British point of view: "We have been pleased to note that the English contracts for electric tramways are being placed more frequently with English contractors, and that in certain cases the English contractors have obtained important contracts abroad in the face of the direct opposition of agents from America. This condition of affairs is gratifying to the profession, but the fact that the majority of the material used, even by English contractors, is obtained from America is to be deprecated. The reason for this is to a certain extent to be found in the fact that the severe competition in America has reduced the prices; but, on the other hand, it is also the fact that in some departments the English manufacturers are not sufficiently prompt to take up the requirements of the new industry. We were informed, for instance, the other day, by a large contracting firm that the steel poles for the construction of an important electric tramway they were equipping had been ordered from an English firm at prices which compared favorably with those of American goods. The order having been placed, considerable trouble arose from the delay in delivery, and the organization of the line was seriously impeded from this cause. Delays of this kind naturally tend to keep the trade out of the country. Another point we have noticed recently, when inspecting new traction plant, is that the American engine builders have paid particular attention to the design of their engines for traction work; whereas the tendency of the English manufacturers is to supply an engine which has been found suitable for electric lighting purposes. It by no means follows that this engine will be suitable for traction work, because the rapid way in which the load varies and the short duration of the periods of extremely heavy loads strain both the engine and its governing arrangements most severely. If our manufacturers will keep themselves to the fore in matters of detail of this kind, we see no reason why the present procedure of ordering goods from abroad should continue. The boom in electric traction which is now commencing will then benefit the English profession and enable the manufacturers to hold their own in colonial tramway equipment. Not only in English speaking countries, but on the Continent electric tramway schemes are being decided upon every day, more particularly, perhaps, in the mountainous regions and other places where there is a plentiful supply of water."

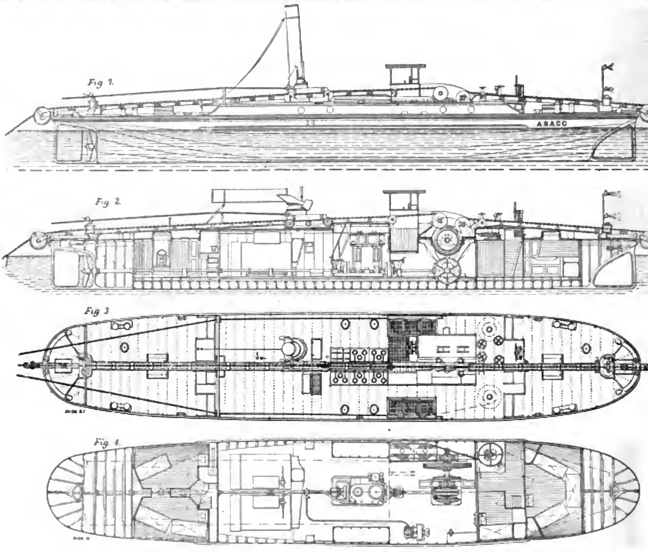
In Australia the American cars are very favorably received, to judge from the following note in Transport: "The railway commissioners of New South Wales are experimenting on the Sydney tram lines with an open car of American make and design. The new car is the theme of local admiration and of eulogistic notices in the press. The old car, which is its companion on the road, is practically deserted. Everybody, in fact, rushes to this elegant and attractive vehicle, which not long ago was publicly tried for the first time. It is said that as a summer car it would be difficult to surpass it. It is perfectly open from end to end, the sun, wind or rain being excluded by cleverly designed blinds, which can be lowered or raised at will, and which, being on the automatic principle, stop just exactly in the position wished. The seats are reversible, being made of light wood, beautifully polished. It runs particularly smoothly, and has accommodation for 40 passengers, with a small cab at each end for the man controlling it. This, of course, is when the car is driven by electricity. The real name is 'The Brill Car,' being manufactured by the firm of that name in Philadelphia. The truck on which it runs is called the 'Peckham' truck. The car being about half the weight of those at present in use, will effect a large saving in haulage."—Western Electrician.

ELECTRIC TOWAGE ON CANALS.

Among the papers read before the spring meeting of the Institution of Mechanical Engineers there was one on "Mechanical Propulsion on Canals," by Mr. L. Robinson. The subject was quite extensively treated in this paper. It was stated that the efficiency of side wheels or a screw applied to towing is half that due to chain haulage. In dead water a chain haulage boat with a force of 100 horse power is equivalent to a tug of 200 horse power; and against a current 100 horse power in the former is equal to 400 in the latter, if the speed of the convoy is equal to that of the current; while if the difference increases rapidly, the speed of the two falls below that of the current. It is evident that the many advantages of the chain (except that of draught) in going up streams disappear in coming down. The heavy chain cannot be allowed to pass over the gear in the boat at too high a speed, and thus it is not desirable to give the convoy as great a rate as that of the current; but, on the other hand, if this speed is approximately maintained, the transit becomes dangerous, and if it falls below, it becomes impossible. From the foregoing considerations it appears that the most efficient system would include a boat adapted for chain haulage going up stream and as a tow in coming down.

The mechanical arrangements that have been devised to maintain the movement of the towing chain have been unsatisfactory and complicated. M. Bovet, a French engineer, has sought to grip the chain by the action of an electromagnet. The magnetized pulley is practically a solenoid with a soft steel core, the two ends of which are extended and brought close together in order to form the two flanges of the pulley. The pulley also possesses features of interest. The adhesion is sufficient to prevent slipping under any conditions that may occur. The first trials of this class of pulley were made with chain towboats built for service on the Seine, below Paris. Only one pulley was employed in the preliminary experiments. Our engraving illustrates an electric towboat for canals constructed for the Compagnie des Touages de la Basse Seine et de la Loire.

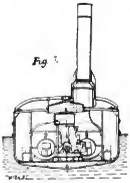
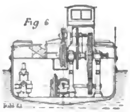
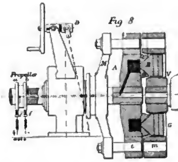
The first boat of this type with magnetic adhesion gear was tried and put on service by the towage company of the Basse Seine, in 1893. It was fully described about that time at the Fifth International Congress of Internal Navigation. (See the published proceedings of that congress; the Memoirs of the Société des Ingenieurs Civils, 1893; and the Revue Universelle, May, 1893.) Three other boats of a similar type have, more recently, been put in service by the same company, and on these several modifications suggested by experience have been introduced. As regards the towing machinery, the changes have been very small, but alterations have been made in the construction and arrangement of the boats themselves, so that they differ considerably from the earliest model. The most recent type is illustrated in Figs. 1 to 6. The section of the Seine on which these boats are running is of considerable depth, and advantage has been taken of this fact to supplement the chain haulage with a screw propeller, and the form of the hull has been modified to suit this auxiliary propulsion. As on all boats of this class where steerage is difficult on account of the action of the chain, two rudders are fitted, one forward and the other aft. The total length measured on the deck is 31 meters (101 ft. 8 in.), and the outside width is 5·470 meters (17 ft. 11 in.); the normal draught of water is 2 meters. The hull is divided into five watertight compartments by four bulkheads; forward there is a hold, and the accommodation for the deck hands, while aft there is a similar hold, and the living room of the machine hands. The engines are placed amidships, and the deck over them is raised 18 in. The construction of the hull and deck is very solid, as will be seen by reference to Fig. 7, where 1 and 2 are the forward and aft bulkheads, and 3, 4 and 5 are heavy double T transverse beams; 6 is a lattice stiffening girder. The girders a, b, with the transverse beams 2 and 3, inclose a hatchway, through which the boilers can be removed if necessary; c and d connect the transverse beams, 3 and 4, and serve as a means of attachment of the chain brake and of the tow hook. The girders, e and f, with the transverse girders, 4 and 5, frame the engine hatchway. The chain well is shown at g and h. The brake, k, and the main frames, l and m, connect the lattice gird-



ELECTRIC TOWBOAT FOR CANALS—BOVET SYSTEM.

er, 6, to the forward bulkhead. The tow gear, that is the two cables by which the convoy is attached to the tug, is fastened to the lattice girder, 6. It is this girder, therefore, which has to resist the chief pull of the chain and the resistance of the tow. In the engine room there are two internally fired boilers with return flues, registered for a working pressure of 8 kilos. (114 lb. per square in.), and each with 50 square meters (538 square feet) of heating surface. A vertical compound engine drives gearing so arranged that it can transmit power to the screw or the chain apparatus. The system of transmission is shown in Figs. 2 and 3. That for the chain is from the main shaft to the driving pulley of the chain, by two toothed wheels keyed to the with the full tow. To facilitate this a shifting gear worked by hand is employed, by which high pressure steam is admitted direct into the large cylinder. It would be preferable on boats of this class to have an independent motor for the screw, and one for the chain, and the arrangement we have described was adopted only on grounds of economy; as a matter of fact, however, the single engine has satisfied all requirements. The chief defect is, that having available a much higher power than is necessary for chain haulage, the crew are tempted to run too fast, and so incur a serious danger of breaking the chain. But it is possible to check this by attaching a speed recorder on one of the chain shafts.

attached to the forward bulkhead; the conductors are laid within wood casings, and the resistances are placed on the right of the chain well. (c) An ejector used for filling and emptying the aft compartment of water ballast; for removing water from the hull and from the chain and pulley well; for washing the deck and chain run, etc. There is a combination of valves by which these various services can be effected with the steam pump of the main engine. Reference was made above to the water ballast in the aft compartment. When running on the chain this compartment is empty, and the boat is practically on an even keel. When running with the screw the compartment is filled so as to bring the stern down sufficiently for the screw,

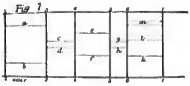
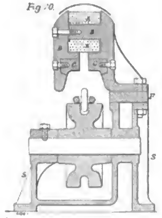
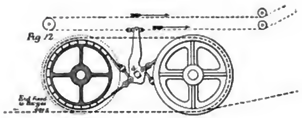
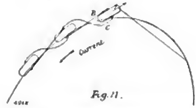
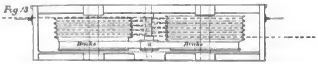







FIG. 14.

ELECTRIC TOWBOAT FOR CANALS—BOVET SYSTEM.

two shafts. As a general principle the boat is only driven by the screw in coming down stream, and the power required for this is higher than for the chain towage; the transmitted speed is therefore greater for the former than the latte[illegible] The engine is designed for working at different spe[illegible]he normal being 150 revolutions when driving th[illegible]nd from 70 to 90 when working the chain ger[illegible]eveloping 150 horse power at 150 revolut[illegible]tion of fuel is 2·2 lb. per horse power [illegible] from the chain might be a difficult op[illegible]y cause it became necessary to stop in [illegible] then start

There are also placed in the engine room the following apparatus: (a) A dynamo and motor for furnishing the current to the various magnetized devices. The engine has two cylinders, and may be worked single or compound; it can exhaust into the condenser of the main engine or into the air, as may be most convenient. This installation furnishes from 30 to 40 amperes, with a consumption of 18 kilogrammes of steam per electrical horse power, when exhausting into the condenser. The maximum power when exhausting into the air is 60 amperes, but with a considerably higher consumption of steam. (b) A distribution board

which is 1·70 meters in diameter. The compartments on each side of the main engine have together a capacity of 11 cubic meters (388 cubic feet).

With the arrangements that we have described, when the boat is driven by the screw, the chain mechanism is thrown out of gear, the screw shaft clutch is coupled and the dynamo is stopped. When working with the chain the screw is uncoupled, though it is desirable to be able to couple it again rapidly and without stopping the main engine, either to keep the boat straight if the chain break or to run it together with the chain. It is true that at the slow engine speed necessary for the

chain haulage, the screw cannot do much to propel the boat, but the wash from the propeller is thrown against the rudder, and helps the steering in turning round sharp bends. In order to facilitate coupling up quickly, a magnetic clutch is added to the mechanical coupling.

The development of this magnetic clutch, of which a large number are now in use, was due to the experiments with the chain pulley already described. It has the advantage of great adaptability, and can be readily thrown on when running, without checking speed or setting up any shock. Such clutches are in service on engines up to 800 horse power, and working at 100 revolutions. Figs. 8, 9 and 10 give a good idea of their construction. In these figures V is the flywheel of the engine; A, M, D are the parts of the ordinary mechanical clutch; excepting that the piece, A, instead of consisting of two arms, is formed of a circular plate with two projections, in which holes are made for guiding the tenons, d. In this disk, A, is cut a circular groove that holds a wire coil, the two ends of which, passing through the center of the main shaft, are led beyond the shaft bearings to two terminals, a, b. On this same disk are fixed the two jaws, c and d, the whole, A, c, d, forming an electromagnet that can be excited by the coil. The armature of this electromagnet is a circular crown of wedge section, B, placed against the flywheel, V, of the engine; it is held in place by four sets of Belleville springs, arranged as shown in Fig. 9, and is capable of attraction to the surface of the electromagnet and of being held there when the latter is excited. This piece, B, is driven by the flywheel through two projections that slide in grooves cut in the flywheel. When the electromagnet is excited the armature becomes fast in the magnet, and the coupling is complete without the action of the mechanical clutch.

The chain traverses the deck longitudinally in the usual manner. Forward and aft are two switches, adapted to suit the oblique movement of the chain, and leading it to fixed vertical rollers, between which its position becomes fixed. Between these pulleys and the towing gear, the chain passes over a series of rollers placed in a watertight trough that collects the drippings and detritus brought up from the bottom. The main tow pulley is almost hidden beneath the deck. One side of the casing containing it is placed far enough away to insure complete magnetic insulation; the casing itself is of wood, lined with zinc. The small taking-off pulley, which has but little work to do, is mounted on the end of its shaft, and has one face thoroughly insulated. The leading-in pulley has, on the other hand, to resist a considerable strain; on account of the change in direction it gives to the stretched chain, it is mounted on a shaft carried in strong bearings on each side. It is an ordinary cast iron pulley, but it can be magnetized, and can be converted into a driving pulley by means of a toothed wheel on its shaft, gearing into another toothed wheel on the main shaft of the towing gear, which transmits movement to the taking-off pulley. The toothed wheel on the leading-in pulley shaft can be shifted so that the pulley can be either idle or driving; it is magnetized only in the latter case. The object of the arrangement, which is not really necessary, is to obtain greater adhesion if required. Directly aft of the towing gear is the chain well, which is introduced to keep on board a certain amount of slack. To the well is added a chain brake that regulates the rate of discharge, and the quantity kept in the well. It consists of a straight electromagnet, placed above the chain run. Fig. 10 shows it in transverse section. It is placed very close to the passing chain, and when magnetized attracts the latter; the rate of travel then depends on the degree of magnetization, and the weight of the chain aft of the brake. On the frame of this brake is mounted the hook used for attaching a tow when the boat is running with the screw. An examination of the drawings will show that when it is desired to take the boat off the chain the latter need not be divided, but the whole of the towing gear can be shifted to one side of the boat. For this operation it is only necessary, by means of the brake, to accumulate three or four meters of slack in the chain well, and to put stoppers on the chain at the switches fore and aft. Of course the boat has to be stopped, but the whole operation does not take more than ten minutes.

The captain has under his hand the steering wheel of the after rudder and the commutator lever, with which he can turn on and regulate the current for the various magnetic devices. The main and taking-off pulleys receive five, twenty-five or thirty-five amperes; the brake can receive three, six, nine or twelve amperes; the magnetic clutch of the screw is thrown in by pressing a button, without any variation in the current. The forward rudder is in charge of one of the crew, who also controls the various towing devices, about which a word should be said. The convoy is always attached by two crossed cables, and these require some manipulation, to insure its taking a proper course. Fig. 11 is a diagram showing a tow passing round a bend; the sketch shows the operation, the cable, B, being tightened and C slacked; if the bend were in the other direction, the maneuver would, of course, be reversed. Usually very large and heavy hemp cables are employed (they weigh five and one-half kilogrammes per meter on the boats of the Compagnie des Touages de la Basse Seine et de l'Oise), and there is a good reason for this practice. It is impossible to start a convoy without throwing a sudden and great strain on the cables, and as the barges are usually of light construction, they would be speedily damaged. But the heavy cables absorb the effect of this shock to a remarkable degree, and thus provide a simple but very effective method of protecting them. On the boats we are describing, an interesting experiment has been made by the use of light steel cables, combined with an elastic device, to absorb the shock. This arrangement is shown in Figs. 12 and 13; it consists of a double grooved drum, similar to the old chain haulage pulleys. The cable takes four half turns on each drum, and the end is rolled around a supplementary store drum. The two drums are held up by means of a brake, the arrangement of which constitutes the novelty of the system. As will be seen in Fig. 12, the brake consists of a band, lined with blocks of wood, and having its ends jointed to the head of a crank free to move around a vertical axis, a, and having a small amount of play in the direction of the tangent common to both pulleys. In this way the compensating action is automatic; the pressure is progressive as the boats forming the convoy are added, and as they move forward the required elasticity is obtained. When traveling the brakes are locked hard, and if it is desired to slacken one of the cables, it is sufficient to release the brake; the storage cable supplies the additional cable required, a light brake checking the tendency to unwind more than is required. On the towboat the bollards and storage drums are fixed under the deck, as is shown in the drawings, in such a way that all the necessary operations are controlled by four handwheels placed near the wheel of the forward rudder. Fig. 14 is a general view of the boat we have described, and shows the forward leading-in pulley, the towing apparatus and the leading-out trough.

THE MAGNETARIUM.

M. WILDE recently presented to the French Academy of Sciences an apparatus which he calls a magnetarium, and which is designed to reproduce the phenomena of terrestrial magnetism and the secular changes of the horizontal and vertical components.

The apparatus consists of two terrestrial globes, one of which revolves within the other. An insulated copper wire is wound around the inner globe, the axis of which makes an angle of 23·5° with that of the outer one, so that its equator revolves in the plane of the ecliptic. The interior surface of the globe is likewise provided with a winding of insulated wire, and the surface of the seas is covered with thin sheet iron, in order to cause a difference between the magnetism of the terrestrial and maritime regions.

The axes are provided with insulated rings, which revolve along with them. Copper brushes in contact with these rings cause electric currents to pass around the surface of the globes. By means of a train

THE MAGNETARIUM.

of epicycloidal toothed wheels, a slow differential motion is communicated to the internal globe, thanks to which there may be accurately reproduced the principal phenomena of terrestrial magnetism and the secular variations of the declination and inclination that have taken place for the last three centuries at London, the Cape of Good Hope, Saint Helena and Ascension Island.

The period of time that corresponds to a difference of one revolution in the rotations of the two spheres is 960 years, and the annual retardation of the electrodynamic sphere is 22·5′. This period comprises all the different secular variations of the magnetic elements upon the different parts of the terrestrial surface.

The apparatus likewise reproduces the various elements that follow: (1) The inequality of the periods of declination upon the same meridians in the northern and southern hemispheres as observed during the short period of western elongation at London (160 years) and during the long period of western elongation at the Cape of Good Hope (272 years) and at Saint Helena (256 years); (2) the simple displacement, in one direction or the other, of the dipping needle for the double movement, forward and backward, and of the declining needle, as it has been observed since the year 1723 in the continuous diminution of the dip for the British Islands during the motion of the declining needle toward the west and its return; (3) the changes of dip in an opposite direction upon the same meridians in the northern and southern hemispheres, as observed during the present period in the dip that diminishes in the British Islands and increases at the Cape of Good Hope, Saint Helena and on Ascension Island; and (4) the rapid increase in the dip in the vicinity of the Atlantic node of the magnetic equator (17 minutes per annum), as observed in the first place by Sabine in the Gulf of Guinea and at Saint Helena, as well as the western progression of this node itself.—La Nature.

TRADE MARKS IN THEIR INTERNATIONAL RELATIONS.*

IN early times manufacturers and merchants took the accumulations of months of labor to fairs, where such were disposed of in a few days—repeating the operation from year to year; but the modern methods of rapid intercommunication have made it possible for them to dispose of their products and purchases as rapidly as manufactured, or collected; hence the disappearance of the ancient fair, and the birth of the international exposition, where goods are exhibited not so much for the purpose of sale as for introduction.

The first international exposition was held in London in 1851, and was followed by an international exhibition in Dublin, 1853; an exhibition of industries of all nations in New York, 1853; a universal exposition at Paris, 1855; an international exhibition at London, 1862; the Paris universal exposition, 1867; and the Vienna exposition of 1873.

What was more natural than that manufacturers and merchants who had, at great expense, exhibited at these expositions should observe and discuss the perils which they ran by reason of want of protection to their marks? It was apparent that without such protection their display was for the benefit of the imitative in the country where the exposition was held. They also observed that goods bearing the same marks were sometimes exhibited by different parties from widely separated countries, and that the authorities were called upon by one to suppress the exhibit of the other.

The necessity for the international protection of marks wherever international trade existed was evident; but not until the exposition at Vienna in 1873 was the matter formally discussed at an industrial congress.

The discussion so commenced was continued at the congress concerning industrial property held at the Paris International Exposition of 1878. By resolution of that congress a committee was appointed to obtain the consent of the French government, or, failing in that, some other government, to take the initiative in calling an official conference of the commercial nations of the world to formulate a convention for the protection of industrial property. The French government happily took the initiative and a conference was held at Paris, commencing November 4, 1880, which drafted the convention for the protection of industrial property, afterward ratified at Paris March 20, 1883, with very slight changes only. This convention covers patents as well as trade marks.

At the conference of 1880 the following states were represented, viz., Argentine Republic, Austria-Hungary, Belgium, Brazil, France, Great Britain, Guatemala, Italy, Luxemburg, the Netherlands, Norway, Portugal, Russia, Sweden, Switzerland, Turkey, United States, Uruguay and Venezuela.

The Hon. William M. Evarts, Secretary of State, in his instructions to Mr. Noyes, minister to France, and to Mr. Putnam, minister to Belgium, as delegates, said:

"The subjects proposed for discussion are in a marked degree important to all countries whose trade and manufacturing industries have attained high development, and this country cannot but feel the liveliest interest in any conclusions which may advance and benefit its commerce and manufactures."

Mr. Putnam, at the conference, referred to the peculiar position of the United States, arising from the fact that power to legislate concerning trade marks was not specifically mentioned in the Constitution of the United States. The trade mark cases declaring the trade mark statutes of 1870 and 1876 unconstitutional had lately been decided in the Supreme Court and were fresh in the public mind. The conference favored the United States by inserting a special clause in the proposed convention to meet its case. This clause was somewhat modified in the convention as ratified. Our delegates took no part in the discussion concerning patents.

The convention was ratified on March 20, 1883, by the following only of the nations represented at the conference, viz., Belgium, Brazil, France, Guatemala, Italy, Netherlands, Portugal, Salvador, Servia, Spain and Switzerland. Salvador has withdrawn.

Since the ratification it has been adhered to by the Dominican Republic, Great Britain, Sweden and Norway, the United States, Tunis, Denmark and Austria-Hungary, with a proviso of legislative ratification.

The salient features of the convention (so far as relates to trade marks and trade names) are:

(Art. 2.) That citizens of each of the contracting states shall enjoy in all of the other states of the union the advantages, so far as concerns trade marks or trade names, that the respective laws thereof accord to citizens; they shall have the same protection as the latter, and the same legal recourse against the infringement of their rights, subject to the formalities and conditions imposed upon citizens by the domestic legalization of each state.

(Art. 6.) That a trade mark regularly registered at home shall be registered and so protected in all the other states of the union, subject to refusal only if the object for which it is asked is considered contrary to good morals and to public order. (Art. 8.) The trade marks shall be protected in all the countries of the union without registration. (Art. 9.) That every production unlawfully bearing a trade mark or commercial name may be seized on importation into those of the states of the union in which such trade mark or commercial name has a right to legal protection. (Art. 10.) That seizure shall be applicable to products bearing falsely the name of a stated locality when this shall be joined to a fictitious commercial name or a name borrowed with a fraudulent intention. (Art. 11.) That protection shall be accorded to trade marks and trade names at international expositions. (Art. 13.) That an international bureau shall be established at Berne.

Foreseeing the probable desirability of revision, it was provided in Art. 14 that "The present convention shall be submitted to periodical revisions for the purpose of introducing improvements calculated to perfect the system of the union. With this object, conferences shall take place successively in one of the contracting states between the delegates of said states. The next meeting shall take place in 1885, at Rome."

* A paper read before the New York Board of Trade and Transportation October 13, 1897, by Francis Forbes.

The conference at Rome was duly held, the United States being represented by Mr. Stallo, United States minister to Italy.

The principal amendment proposed was an addition to Art. 10, that every product bearing a false indication of origin should be seized on importation into any one of the contracting states; and that the seizure might also take place before shipment or after importation. Also for temporary protection of inventions, designs and models appearing at international expositions.

These propositions were not ratified by all of the contracting states, and therefore failed.

The United States adhered to the convention in 1887 and under an act of Congress (26 Statutes at Large, page 17) sent three delegates, Hon. Thomas W. Palmer, minister to Spain, and Messrs. F. A. Seeley and Francis Forbes, to the succeeding conference at Madrid in 1890.

The conference at Madrid, because of the failure of the propositions of the conference at Rome to receive universal assent and to be incorporated into the convention, adopted the expedient of subsidiary conventions and unions, which have gone into effect between the several powers which have agreed to them only.

There are two of these subsidiary conventions, both signed at Madrid April 14, 1891, viz.: One for the suppression of false indication of origin, i. e., the seizure of all goods bearing any mark indicating a place of manufacture or production other than the true place. Such goods are to be seized in the country of production, on importation into another state, or in the latter state, or, in case the laws of any state do not permit of seizure, such other remedies are to be taken for repression as are allowed by the laws of that country. (The latter clause was added at the suggestion of the delegates from the United States.)

Art. 3 permits the vender of goods coming from another country to indicate his name and address, but in that case the address or the name must be accompanied by a clear indication in legible characters of the country or place of manufacture or production.

The following nations have adhered to this subsidiary convention: Brazil, France, Great Britain, Portugal, Spain, Switzerland and Tunis.

The other subsidiary convention provides for the international registration of trade marks, to which Brazil, Belgium, France, Italy, Netherlands, Portugal, Spain, Switzerland and Tunis have adhered. Also Austria-Hungary, with a proviso of legislative ratification.

International registration under this agreement is a purely diplomatic affair. The citizen of a government adhering to the union applies to his government to register his mark for him at the International Bureau at Berne, and the bureau in turn forwards such mark for registration to the other states of the union. The fees are only those of the various governments, and in addition an almost nominal fee for the International Bureau. The registration being thus made is freed from any of the risks attendant upon the work of making separate registrations in the separate countries.

The convention of Paris of March 20, 1883, for the protection of industrial property is of the greatest importance to trade mark owners in the United States, since it makes provision for the time in the growth of their several businesses when they will overflow national bounds and become international.

Without any international agreement and with each government acting according to supposed local interest, the same trade mark might be used in many different countries, with the result of limiting the trade of each user of the mark to certain geographical bounds.

An example of what we mean recently appeared in the Belgium Trade Mark Journal, which publishes officially all registrations. In vol. 9, at page 43, occurs a statement of the registration of the trade mark "Okonit" for an insulating compound for electric cables, etc., by a German firm. Now, "Okonite" is a well known trade mark here for the same article, and is registered at the Patent Office in Washington.

Another example is that of two prominent starch manufacturers, one of whom has a trade mark registered and long in use in this country, but little trade abroad. His rival has commenced to use the mark in England but not here, and has applied for registration there, which is being opposed. It is said that, if the registration is granted to the applicant in England—who does not use it here—he can stop the manufacturer here from shipping to England. This is not an enviable condition for a future expansion of the trade of the originator of the mark.

These examples show the serious nature of the question of international registration, and of treaties to protect marks in their international relations.

A third conference under the convention has been called to meet at Brussels, Belgium, on December 1, 1897. This conference is held in France to be of such importance that numerous propositions for the amendment of the convention have been forwarded (according to newspaper reports) to the various chambers of commerce throughout the republic for their opinion. It should awaken the liveliest interest in our own manufacturers and merchants, also expressed through their boards of trade and chambers of commerce.

It is to be observed that the convention for the protection of industrial property contains the following article:

"Art. 15. It is understood that the high contracting parties respectively reserve the right to make, separately, between themselves, special arrangements for the protection of industrial property so far as these arrangements shall not interfere with the provisions of the present convention."

The United States has made special treaties in regard to trade marks with the following nations: Austria, 1871; Belgium, 1881; Brazil, 1878; Denmark, 1892; France, 1869; Germany, 1871; Great Britain, 1877; Italy, 1882; Russia, 1874; Servia, 1881; and Spain, 1882.

We are not alone as a nation in our interest in foreign trade, as is demonstrated by the various treaties to which reference has been made. All history now points to the reaching out of the civilized nations toward the uncivilized in order to supply the latter with the refinements of civilization in exchange for raw products. We have heretofore been principally producers of these raw products, such as wheat and cotton. We are now, however, producers of manufactured articles requiring the highest skill, it behooves us, therefore, to enter vigorously into all movements which will protect not only the marks of our own citizens, but those of other countries similarly situated. By this co-operation we shall deal fairly and honestly with our neighbors, which fairness and honesty will redound to our own advantage as a nation.

NEW DEPARTURE CHEMISTRY.

By Dr. E. C. TOWNE.

IN the initial issue for the current year of The Electrical World, Prof. Elihu Thomson had an article entitled "Fuel Energy into Electrical Energy," and the editor of the publication referred to the article as treating of "the direct conversion of fuel energy into electrical energy," "electrical energy direct from the energy of fuel."

Prof. Thomson stated the problem as that of "how to obtain an increased efficiency or a greater percentage of the potential work of a fuel as electric energy." He spoke of the steam engine as effecting "the conversion of the potential energy of the combustible into electric energy," and referred to the claim made for the Jaques battery that "as high as 85 per cent. of the energy represented by the solid carbon is thus converted into electrical energy."

"Fuel energy," "potential energy of the combustible," "energy represented by the solid carbon," and "electricity direct from coal," means carbon which will do two things: (1) Incandesce of itself by its own electricity, and (2) give off extra electricity. But the fact is that carbon is absolutely inert and passive, a fixed solid, and able to do nothing whatever of itself. These statements of Prof. J. P. Cooke's "New Chemistry," exceptional as they are, are perfectly correct:

"Carbon is peculiar in this respect: In all its conditions, whether of diamond, graphite or coal, it is one of the most fixed solids known. Even when exposed to the highest artificial heat it never loses its solid condition.

"Since carbon, in all its forms, is non-volatile, the molecules of the charcoal [burning in pure oxygen] cannot leave the solid lumps. They do not, therefore, go half way to meet the oxygen molecules, but simply receive those which are driven against the surface of the coals. Hence the process depends on the activity of the oxygen molecules alone.

"The glowing particles of charcoal [finely pulverized, made red hot and sifted into pure oxygen], after they have become incandescent, retain their solid condition until the last atom of carbon is consumed.

"The material of the burnt charcoal is taken up into the gas atom by atom, actually absorbed by it as a sponge absorbs water. Every molecule of oxygen which strikes against the charcoal flies off with an atom of carbon, forming with it the molecule of carbonic dioxide."

The oxygen molecule is one of two atoms, O-O, and this molecule becomes O-C-O, but the physics of the operation is probably not that of absorption, or as Mendeleef, greatest of modern chemists, says, a carbon atom squeezed in between the two oxygen atoms. It is far more likely that the carbon atom hangs upon the oxygen molecule $\frac{O\text{-}O}{C}$, and that, just as ozone, $\frac{O\text{-}O}{O}$, is three-atom oxygen, with the third atom hanging on to the molecule, but not wholly incorporated, so our CO_2, or $\frac{O\text{-}O}{C}$, is carbonized oxygen, with a purely oxygen history before it, in the relation of CO_2 to plant life.

But this apart. What I wish to say here is that the energy of combustion, or of any union of oxygen with a combustible like carbon, or any attack of oxygen upon carbon, is wholly oxygen energy and is no carbon energy at all, and that all getting of electricity direct from combustion of any kind is getting it from the oxygen.

The Chinaman who, after watching the action of the cable car, said, "No pushee, no pullee—go like mad," is quoted by Prof. Lodge as a philosopher, with this declaration: "Remember that, whenever we see a thing being moved, we must look for the rope. Unless there is either 'pushee' or 'pullee,' there can be no action. And if you further consider a pull, it resolves itself into a push [as the pull of a horse by pushing against the collar to which the pulling traces are attached]. We may make this general statement: The only way of acting on a body directly is to push it behind."—"Modern Views of Electricity," p. 291.

The push of steam in the piston gives the pull of the railway train, but the initial push is that of the oxygen of combustion as it pours into the engine fire. How that push of oxygen gas against the atoms of carbon fuel can have the tremendous efficiency required to push the engine and train is the problem which a railway train presents. It is evident that the direct forward push of the mass of oxygen cannot amount to anything. There must go with this some other push incalculably greater, and this can only be (waiving exact explanation) the push of the electrical charge of the oxygen.

The oxygen molecule, by reason of its electrical charge, has the necessary push, and if we are to read actions aright, we must invariably note this push of oxygen, and on no account suffer the conception of "attraction" to intervene. Instead of saying "intense affinity for oxygen," we must say energetic intensity of oxygen to unite with, to seize and hold fast, or to seize and carry away. So, also, if we note what action occurs in electrolysis, we must see electrical charge increasing the push of oxygen and throwing it back upon the anode. In the storage battery, oxygen electrical push is held in leash on the peroxide. It is a survival of the false "attraction" view which causes Thompson to ascribe "high chemical activity" to the hydrogenated lead, and to tell us that the cell does not store electricity, but rather stores energy in the form of chemical work. The energy is nothing else but the electrical charge of the oxygen of the peroxide. Electricity was driven into the peroxide, and the same electricity flows out again. It is oxygen push, at any rate, and it is hardly less plain that the push is electrical. "Chemical work" and "energy" mean nothing. We are using sound sense in seeing that oxygen push is the thing, and once that we see this, we may almost take for granted that this push is electrical. It is only dreadfully poor thinking which permits us to say that a cell which we have loaded up with electricity, and out of which we can get that same electricity, is not a storage-of-electricity cell.

And when we correctly note the electrical character of sun energy, we must also note that it is invariably related to oxygen, and not to carbon. If we remark the immense part played by the so-called carbonic dioxide in supplying, by way of entrance into their leaves, the chief substance of all plants, we must take care to see how the oxygen molecule and the sun co-operate. In the first place, pure oxygen is every moment the breath of life of the plant, precisely as of the animal; and it is by its own push that the oxygen beats into the protoplasm cells of the plant. It is not drawn in; not even in ourselves is it drawn in, for its entrance into the lung capillaries and the corpuscles of the blood; it pushes its own way; it alone is active; we are wholly passive; the whole of the driving energy of the animal system is oxygen push; the whole animation and order of vital movements in the plant is due to oxygen push; and no mistake can be greater than that of fancying that somehow the plant is run by sun energy apart from oxygen. Sun energy operates upon the oxygen and acts in the plant through oxygen.

Thus the oxygen which has come into union with carbon, each molecule of the oxygen carrying an atom of carbon, has its push intensified in sunlight; it pushes into the protoplasm cells of the leaves of plants, carrying its load of carbon; and the sun still augmenting its electrical intensity, it is helped to shake off its carbon and to push out into the air, with the wholly incidental result that the plant can use the carbon as food for its growth. The carbon benefits, and the plant, through the value of the carbon to it, benefits by the energy of the sun, but it is the oxygen of the carbonic dioxide on which the sun's ray especially act, helping it to push into the leaves of the plant, and then helping it to shake off its carbon load and escape into the air with fully restored intensity. Cooke states that oxygen and carbon combine in the proportion of 100 grains of oxygen to 37½ grains of carbon, and that every ton of coal burned yields 3⅔ tons of carbonic dioxide. That is to say, the work of burning a ton of carbon is done by 2⅔ tons of oxygen. The great new German steamship is said to have bunkers for 4,950 tons of coal. If the coal were pure carbon, this would mean 13,200 tons of oxygen to do the work intended by the amount stated of coal, and 18,150 tons of carbonic dioxide going off into the air through the carrying energy still left in the oxygen. It might serve a good purpose to give adequate attention to the tremendous weight of tremendously energetic oxygen implied by eight tons of oxygen to every three tons of carbon, and oxygen with carrying energy sufficient to keep its flight as a gas after every molecule has taken up an atom of the passive, inert carbon. "Lavoisier inferred," says Cooke, "that oxygen must be the chemical center in the scheme of Nature." Its electrochemical energy is what gives oxygen its supreme place. The driving energy of our fires and light-giving flames, and of all vital activity in both plants and animals, is the electrical charge carried by the oxygen of the air.

SEWING NEEDLES IN GERMANY.

THE sewing needle, though small, forms a very important article of commerce in Germany. While formerly England supplied that country with needles, this industry, according to the United States consul at Annaberg, has during the last few years developed to such an extent that the Germans are able to meet their English competitors, not only on the markets of the world, but in the British colonies and in England as well. The principal seats of the industry are Aix la Chapelle, Burtscheid, Iserlohn, Altona, Nuremberg, and Schwalbach. The factories of Aix la Chapelle alone produce 50,000,000 needles weekly. The following figures show to what extent the exports from Germany of these needles have developed. During the eight years from 1880 to 1887 the German export of needles of all kinds (embroidery, knitting, darning, sewing and sewing machine needles) amounted to 11,000,000 lb., of the value of £2,500,000. The following eight years make a still better showing. During this period the quantity exported was 15,000,000 lb., valued at £3,000,000. The enormous growth in the production of this article is due principally to the export trade to China, where Germany seems to entirely control the market. Other countries importing German sewing needles are British East Indies, France, the United States, Austria-Hungary, Italy and Turkey. In conclusion the American consul says: "Under the protection of their government the Germans have built up a needle industry which commands the respect of the world. At first they imitated the English methods of manufacture, but their superior technical training soon enabled them to discover the defects of the English machinery, and they adopted new and improved devices, and followed their own course of manufacture. The infant industry of a few years ago has become one of national importance. The manufacturers go into the markets of the world, preferably into new countries, and compete successfully everywhere."—Journal of the Society of Arts.

DANGER OF EXPLOSION AND FIRE IN THE MANUFACTURE AND STORAGE OF ALUMINUM BRONZE COLORS.

THE author observed repeatedly that the aluminum bronze colors became oxidized in the settling vessels to aluminum hydrate with evolution of hydrogen. The decomposition by water only took place if the temperature of the rooms in which were the settling vessels rose above 25° C. The evolution of hydrogen begins slowly, but in consequence of the heat of the reaction, becomes very vigorous. As there may be present in a settling vessel six kilos or more of the bronze color capable of evolving at least seven cb. m. of hydrogen, there is the possibility of a dangerous explosion by the formation of considerable quantities of inflammable gas in the rooms. By the admission of moisture and heat to packed aluminum bronze, evolution of hydrogen may take place, and if the packing material be inflammable, may lead to fire. Spontaneous combustion of aluminum bronze colors was also caused by friction or blows, due probably to small quantities of fat adhering to the powder. These phenomena were not observed with bronze colors made from copper zinc or copper tin alloys.—Zeits. Oeffentl. Chem.

Recent Books.

Experimental Science. By George M. Hopkins. This book treats on the various topics of Physics in a popular and practical way. It describes the apparatus in detail, and explains the experiments in full, so that teachers, students and others interested in Physics may readily make the apparatus without expense and perform the experiments without difficulty. The aim of the writer has been to render physical experimentation so simple and attractive as to induce both old and young to engage in it for pleasure and profit. A few simple arithmetical problems comprise all of the mathematics of the book. Many new experiments are here described for the first time. It is the most thoroughly illustrated work ever published on Experimental Physics. 840 pages. Over 780 illustrations. Seventeenth edition. Revised and enlarged. 8vo, cloth. $4 00

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STEAM YACHT FOR THE ENGLISH AMBASSADOR AT CONSTANTINOPLE.

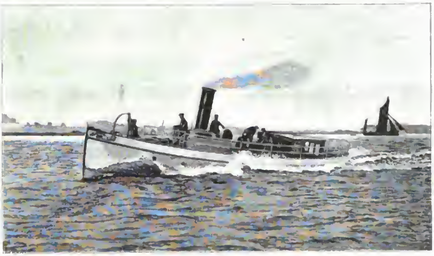
MANY of our readers, says the London Engineer, will no doubt be surprised to learn that although all the ambassadors of the chief Continental powers in Constantinople have for many years had very excellent steam launches attached to their embassies, the representative of Great Britain in that city has been without one until very lately, an omission which has been owing to the want of decision as to who—the Foreign Office or the Admiralty—should bear the cost of supplying and maintaining such a vessel.

The Thames Ironworks Company has completed a steam launch, or rather yacht, for the special use of his Excellency our ambassador at Constantinople, illustrated herewith.

The dimensions of this vessel are: Length on the water line, 60 ft.; breadth, 10 ft. 9 in.; depth, 5 ft. 5 in.; and water draught, 3 ft. 5¼ in. forward, and 5 ft. aft. She is fitted with compound surface-condensing engines, the high pressure cylinder being 9½ in., and the low pressure one 19 in. diameter, both with a piston stroke of 10 in., driving a single screw. The engine bed plate is built up of two longitudinal steel bearers extending the whole length of the engines, to which are bolted the cross main bearing brackets, made of manganese bronze. The columns supporting the cylinders are of forged steel, braced diagonally, as shown. The air pump is driven by a small crank overhung at the end of an extension of the main crank shaft, the feed pumps being worked by a worm on this shaft gearing with a worm wheel for reducing their speed, the ratio of the gear being 3 to 1. Great care has been taken in balancing the main crank shaft, with the result that, at a speed of 500 revolutions per minute, perfect steadiness is secured, without any perceptible vibration.

The steam distribution valves are of the usual type fitted to high speed engines, that on the high pressure cylinder being a piston valve, while for the low pressure a flat double ported valve is used, with the exhaust passing through its back, thus relieving it from face pressure, and rendering it practically a balanced valve. Cooling water is supplied to the surface condenser by a centrifugal circulating pump driven by an independent engine.

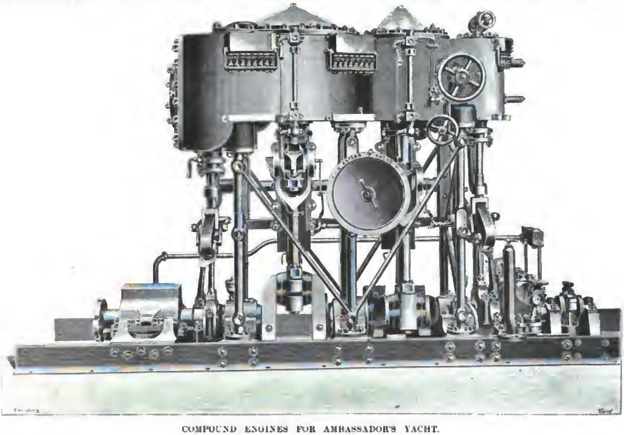
Steam for the engine is supplied by a Thames Ironworks patent water tube boiler of 18 square feet of fire grate surface, and 772 square feet of heating surface in the tubes, and like all of the similar make of boilers fitted in the Admiralty steam pinnaces made by the company, works without priming, and maintains a steady water level and steam pressure. The boiler is weighted to 185 lb. pressure per square inch at the safety valves, a forced draught at an air pressure of 4·2 in. in the stokehold being obtained by means of a fan driven by an independent engine. All Admiralty safety appliances have been introduced, thus making the machinery one of the most advanced examples of the small high speed type.



YACHT OF THE BRITISH AMBASSADOR AT CONSTANTINOPLE.

On the trial of this yacht, which took place shortly before she left the Thames for Constantinople, the mean speed realized on six measured miles, with the engines developing 861 indicated horse power, was 15·485 knots, and on a 2½ hours' continuous run 15·28 knots an hour, the mean revolutions of the engines being 512·85 per minute; the force of the wind being 2 and the sea smooth, hand picked Welsh coal being used.

As will be seen from the longitudinal section of the vessel we give in Fig. 1, there is good accommodation forward for the small crew required; and a very commodious saloon aft, with lavatory, pantry, etc., in addition to ample quarters for his Excellency the ambassador and any notables or friends to whom he may have to give audience, or meet at different times. The vessel will supply a long felt want at Constantinople, and will bear favorable comparison with any others running on the Golden Horn. She is built of two thicknesses of teak, with waterproof canvas between them, and is copper fastened throughout. Her keel, stem, and stern post are of English oak. She was designed by Mr. G. C. Mackrow, naval architect to the Thames Ironworks Company, and is an excellent speci-



COMPOUND ENGINES FOR AMBASSADOR'S YACHT.

men of the work turned out from the Orchard Shipyard and Engineering Works, Blackwall.

AMERICAN NAVAL ENGINEERS.

As our readers are aware, the engineers of the United States Navy have not been altogether satisfied with their position and the recognition they receive for their certainly arduous services. As there is no other navy so nearly akin to our own in regard to its personnel as that of the United States, an examination of certain proposals recently put forward will be of more than vicarious interest to us. The American naval engineers have found an able spokesman in the person of Professor Ira N. Hollis, who was formerly an officer in the corps of United States Naval Engineers. This gentleman has set forth his ideas in an article which appears in a recent (September) number of the Atlantic Monthly, a magazine published in Boston, U. S. It is safe to say that the views expressed by Professor Hollis have the support of, at any rate, a large section of the corps to which he formerly belonged. It is said that the propositions set forth were submitted to the Navy Department at Washington before the article appeared and that the Secretary (Mr. Long) and Assistant Secretary (Mr. Roosevelt) of the United States Navy are both very much interested in the matter. This naturally does not mean that the scheme has official sanction, and it is, of course, impossible to say what view the United States Congress may take of the matter. The position of the line officers—who correspond to our executive officers—is not altogether cordial toward Mr. Hollis' proposals, a fact which might be anticipated from the nature both of the proposals and the line officers. A number of the latter holding high rank have written to the department protesting against the adoption of the suggested plan. Nevertheless, we are informed, some of the younger and more thoughtful of the executive branch think well of the scheme, or at any rate think reforms on the lines indicated might be advantageous to the efficiency of the United States Navy.

So much by way of preface, but before proceeding to examine Mr. Hollis' scheme it may be remarked how strange it is to find the professor, in dealing with the navy of so modern and "go-ahead" a people as the Americans, opening his article with the statement that the last few years "has marked the complete break, perhaps forever, with the old line-of-battle ship, dependent for its motion upon an unreliable element, and the adoption of the powerful hull driven by a machine whose reliability depends only upon the care and foresight of men;" in other words, the United States has now steamers in place of sailing ships for the line of battle. Now, it would hardly more enter our heads in this country to emphasize this fact than it would to state that the Household Troops are no longer armed with bows and arrows, yet we organize the personnel of the navy very much as if James Watt had never lived and we were still in the glorious old days of "Nelson, Hood and Collingwood," when ponderous three-deckers sailed leisurely into action, and then lay, yard arm to yard arm, blazing away for hours until one or other had had enough of it, or there was a chance to board and settle the matter out of hand. In frigate actions it was somewhat different; but, heroic as these generally were, they constituted only the skirmishes of the seas, and had but small influence on the fate of nations. But even if the "motive power" had played ever so important a part in the decision of sea fights, the difference between then and now is that formerly the executive officers were thoroughly masters of the whole "mystery" of the propelling agency, whereas nowadays a captain in the engine room is about as useful as a marine at the weather earring. So far as we can judge, our emancipated and non-aristocratic cousins in America are little if anything ahead of us in this matter, and perhaps Mr. Hollis does well to remind Americans that they too have a steam-driven navy.

Mr. Hollis is commendably plain spoken in dealing with his subject. "For thirty years," he says, "there has been a struggle between the line and the staff of the navy; or between those officers who may succeed to the command of ships and those who may not. This struggle has developed the greatest bitterness between the line and the engineer corps." He goes on to point out that "the men in the compartments containing guns and ammunition and the men in the engine and boiler rooms must stay." They are both essential. "They belong to the fighting machine." It is further of paramount importance that "they must work in entire harmony toward the same ends," not only that they may live in peace among themselves, which is most desirable, but also "to attain the highest qualities of the ship." It is apparently in the American Navy, as in the English service, that "questions between the line and the engineers are carefully avoided at well regulated mess tables;" but it will be seen that such questions exist, and are of a very burning nature. Mr. Hollis compares the situation to being "penned up in the crater of a volcano," and attributes to this cause the reason of many graduates of the naval academy having left the service.

The situation is not so acute as this in the British Navy, but the conditions are somewhat different in regard to the national character and aspirations. In the United States the line and staff are brought up together until they enter the service, being graduates of the same school. There is no quarrel so bitter as the quarrel between brothers, and so it is that a sentiment of equality having been planted during the period of pupilage, it is very difficult for one branch to give way to the other in regard to accepting a position in which it must always receive and not give orders. This is the chief circumstance in which the training of the personnel in the navies of the two nations differ. With us the executive and engine branches are educated apart. Keyham never thinks it has the same function to perform as Dartmouth, and both branches enter the navy with a well defined status, which, in itself, is a great protector of harmony. Under existing conditions of service we prefer the English plan.

Mr. Hollis would put an end to the undesirable state of affairs in the United States Navy by the often suggested plan of fusion. "The only solution of the matter lies in fusing together the line and the engineers, and in making them all the line, except a small number, selected for technical attainment in engineering, to do the duties of chief engineers on board and on shore. All officers except the chief engineer, surgeon and paymaster would then be available for deck or machinery duties. . . . The navy could not fail to gain enormously by the greater engineering knowledge of the commanding officer and the increased interest of the chief engineer, in whose hands must be placed everything connected with machinery, whatever its nature, on board a ship." In regard to the last sentence, it will be gathered that the functions of the American line officer are already more of an engineering nature than is the case with the executive officer of the British Navy. In our service the engineering branch is responsible (it is true, to the executive) for all the mechanical and constructional parts of the vessel, including watertight doors and double bottoms. Later on, Mr. Hollis says: "Let the commanding officers become engineers, and let engineers rule our ships; then all fears will be dispelled, and the navy will quickly become a unit;" the fears referred to being those attributed to the line officers that "the engineers wish to command the ships."

It would savor of impertinence on our part were we to attempt to decide what is and what is not desirable for the United States Navy, but we think that the most ardent advocate of "fusion" will agree with us when we say that the author of the article has proposed a very difficult and thorny programme. He has, however, the courage of his opinions, for at the end of the article he gives thirteen suggestions for carrying out the scheme he advocates. It will be fairer, perhaps, if we give these in full.

1. To make the course at the Naval Academy the same for all cadets, with a strong emphasis on engineering.

2. To give all graduates, except those entering the marine and construction corps, commissions as ensigns of the line.

3. To require all line officers to spend their first six years at sea, equally divided between responsible duties on deck and in the machinery department.

4. To permit any line officer to specialize in engineering during his second six years as a commissioned officer, and at the end of that time to transfer him to the engineer corps through examination in engineering.

5. To require at least one officer of the engineer corps on every ship, and to place under his charge all that pertains to machinery on board, including the men required for engineering matters.

6. To give all watch duties connected with repairing and driving machinery to line officers under the direction of the chief engineers.

7. To promote all officers of the line and engineer corps at the same rate and to the same ranks.

8. To make the total number of line officers and engineers together what it is now by law, with a minimum of about 100 officers in the engineer corps.

9. To regulate the flow of promotion by permitting a limited number of officers to retire after thirty years' service.

10. To provide a "reserve list" for officers who do not reach command rank young enough to be effective.

11. To promote all ensigns after three years' service in the grade.

12. To transfer to the line all officers of the present engineer corps who have held their commissions less than twelve years.

13. To establish a general staff in whose hands shall be placed all matters connected with the preparations of war.

It will be seen that Professor Hollis' proposals take a wide range, and it is questionable whether he has been wise in this respect, for he has given many opportunities for those opposed to him to attack on side issues. The main proposition, however, is clear enough; it may be summarized in the word "fusion." "Let the commanding officers become engineers, and let engineers rule our ships," he says elsewhere. Now, we have had proposals something on these lines in regard to our own navy, but they were not nearly so comprehensive as the scheme of Mr. Hollis, and they have borne no fruit: fortunately so, for it was suggested to give executive officers a superficial knowledge of engineering subjects, in order that they might have a greater semblance of authority in the engine room. Thus it will be seen that even the executive branch could not altogether blind itself to the absurdity of existing conditions; and no doubt executive officers felt that power and dignity would some day pass out of their hands into the hands of those having knowledge. The scheme they proposed was, however, so absurd and untenable that there never was a prospect of its being put into force. Mr. Hollis, it will be seen, would proceed on very different lines.

No reasonable person will deny that the officer in supreme command of a modern warship would be better equipped for his duties had he a knowledge of all parts of the vessel—including the propelling machinery—such as the captains of past eras had. The sole question that remains is, therefore, whether it is within the bounds of reasonable anticipation that such knowledge can be acquired without detriment to other qualities absolutely essential to taking a ship into action. Mr. Hollis appeals to "the teachings of history" in support of his contentions. He draws a most interesting parallel based upon what occurred in the English service 400 years ago. Before the sixteenth century the sailor occupied a somewhat similar place to that of our engineer, and the soldier took the place of our sailor. That was when seamanship, as we understood it, did not exist, and ships were little more than hulls, which were useful only for bringing soldiers to a hand-to-hand fight. The discovery of the art of sailing on a bowline, or beating to windward—which took place about the era of Sir Walter Raleigh—and the use of guns afloat altered all this, for seamanship thus became an art, by the exercise of which a military advantage could be gained. The man who could maneuver a ship thus held the key of the situation, and gradually, but not without a struggle, the sailor asserted his superiority afloat, for his knowledge of seamanship by no means detracted from his fighting qualities. The contest for supremacy was long and bitter, lasting, Mr. Hollis says, for over two centuries, but it gradually died away, being obliterated by a process of "fusion," such as is now recommended. "Some of the soldiers learned seamanship, some of the sailors learned the handling of guns, so that it was seamanship rather than the sailor that captured the command."

It was in virtue of this "fusion" that England gained the mastery of the sea, and to it Mr. Hollis very rightly attributes our victories in the Elizabethan era. Our fleet was intrusted to sailors—Drake, Hawkins and Frobisher—while the Spaniards clung to the ancient system of soldiers in command. "The poor equipment of the Spanish ships (of the Armada), and the ease with which they were rounded up, like a herd of cattle, forms one of the most melancholy pages of history," says Mr. Hollis. Englishmen naturally take rather a more cheerful view of the matter, but that does not affect the argument. Nothing, however, is easier than to misapply the teachings of history, and it by no means follows that because the navigating sailor and the fighting man of 300 years ago could be "fused," the captain and chief engineer of the present day can be welded together with equal success. The whole tendency of modern advancements ashore and afloat is toward specialization and division of labor. The problem of civilized existence is so complex, there are such vast stores of accumulated knowledge to be acquired, that life is not long enough to enable a man to become efficient in more than one branch. In the yard arm days there was one sort of gun, one sort of gunpowder, and but few sorts of shot. Small arms—smooth bore, pike and cutlass—were equally simple. Navigation was not more difficult to master—it was more uncertain in practice—than it is in the present day; but now we specialize into gunnery lieutenants, torpedo lieutenants, and navigating lieutenants, with whole systems of sciences to learn, and furthermore, a science of naval strategy and tactics such as the mast-and-sails commander never dreamed of. Even in the sailing days the maneuvering of the ships was left to the master, who remained as a relic of the old struggle between sailor and soldier, to which reference has been made.

So much may be said against the "fusion" scheme Mr. Hollis proposes, but the objections are by no means final. In support of his suggestions it may be said that, with the exception, perhaps, of strategy and tactics, the whole duties of the executive officers—gunnery or torpedo—are based on engineering science, all branches of which have a common foundation of elemental principles; and even strategy and tactics depend on the machinery department. Whether, therefore, the complete naval officer—at once steam engineer, gunnery expert, torpedoist and navigator—be possible is the question that has to be solved. It is no good for him to get a smattering of steam, just enough—as some now have—to make himself ridiculous. He must go honestly through the mill, and know his engines and boilers as he knows his guns and torpedoes, and that is a question of time. We cannot afford to have naval officers growing into old men before they have learned their business.

Whatever training the commander of a ship may go through, there is one thing certain, his place in time of battle cannot be in the engine room. Therefore, the captain of the ship can never be, at the same time, the chief engineer, whatever his previous training and his engineering accomplishments may be. If, however, the captain cannot be the engineer, the engineer can become a captain; and, indeed, the present regulations which put an engineer officer under the orders of a gunner or a boatswain, in absence of a commissioned executive officer, are an anomaly which should speedily disappear.

There is one other point to which we would make reference, although it is not dealt with in Prof. Hollis' contribution, before concluding this article. We refer to the question of titles as apart from rank. In our own navy all engineers, from the engineer in chief downward, have no title or designation in virtue of their office, standing on the same platform as ordinary civilians in this respect. In the United States it is somewhat different, as there naval engineers holding high office are allowed combatant titles; for instance, the chief engineer of the United States Navy is known as Commodore Melville. At first sight this seems a small matter, and for our own part we have always considered the profession of the engineer so honorable that it carried distinction sufficient in itself. In the navy, however, there is doubtless more to be said, especially in regard to vessels serving abroad. In foreign countries it is customary for naval and military officers to be addressed by the name of their rank; that is the distinguishing mark of "an officer and a gentleman." If, therefore, a naval lieutenant and a naval engineer are in foreign society, and the engineer is simply Mister Jones, while his brother officer is Lieutenant Smith, the former gets very small consideration, and no doubt people often wonder whether he has any right in the drawing room at all. This is annoying even to the most philosophically inclined engineer, and though those not subject to the same disadvantage affect to make light of these matters, we have noticed that captains, and even admirals, are not overpleased if their rank is forgotten. The fact is the great inducement to the majority who join the combatant services is not the prospect of high pay and material advantages, but the honorable distinction and social prestige attached to the holding of a commission, and of this the military prefix is the outward and visible sign. As there are gunnery lieutenants, torpedo lieutenants, and navigating lieutenants, why not engineer lieutenants? It is said the engineer is not a combatant; that is a fiction. The whole war ship is a weapon of offense, and in handling the engines the engineer performs an act of fighting below as much as the captain does when he works the telegraphs in his armored conning tower on deck—especially if ramming operations are in contemplation—or as the torpedo lieutenant does when he directs the operating of a submarine torpedo discharge, also below the water line. The engineer officer wears a sword and we should like to ask whether, in the case of his ship being boarded, he would be expected to tamely submit to his engines being interfered with by the enemy so long as the colors were at the mast.—London Engineering.

The largest locomotive in Europe, and probably in the world, has just been completed at Liége to the order of the Belgian government. It is built on the compound system, having four cylinders, two each of high and low pressure, with respective diameters of 32 in. and 20 in. The wheels, of which there are twelve, have a diameter of 52 in. The extreme length of the locomotive is 55 ft. 6 in. and its weight is over 200 tons.

THE MANUFACTURE OF BRIQUETTE FUEL.

DURING the last two years there has been an abnormal supply of small coal on the market, which has partly been absorbed in the manufacture of coke, partly used in ordinary industrial undertakings and partly resolved into the form of briquettes. Nevertheless, the supply has been so much in excess of demand that in many districts small coal has been sold at perhaps not more than half of the cost of production, assuming that cost to be—as it really is—the same for small as for large coal. Increasing attention is now being given to the use of such coal for the manufacture of briquettes, which have been found specially well adapted to locomotive and shipping purposes, and can be exported to greater advantage than almost any other form of fuel. Much, however, still remains to be done in this direction, and the moment, therefore, appears to be opportune for reviewing the development of briquette fuel and making suggestions affecting its manufacture and applications in the future.

Like many other inventions and applications, it is difficult to fix either the period or the place of the first practical employment of a moulding process for the manufacture of small coal into bricks with the admixture of coal tar or bituminous matter. The first name extensively connected with the subject in this country was that of Mr. Warlich, who applied the process in South Wales with considerable success. About 1853 Messrs. E. and B. Johnston, of Chester, were the makers of some sets of mixing and moulding machinery employed in the North Wales coalfields, but except in the principality, very small use was made of the system.

On the Continent more general use has been made of methods for the consolidation of coal slack. Extensive use was made of it as a locomotive fuel within a few years after the first lines were opened on the Continent, and its employment may be said to have been general before 1850. The machinery for mixing and moulding now most generally employed in France and Belgium is that suggested by M. Evrard, and extensively used in the St. Etienne coal district, models of which were shown at the first Paris exhibition. This system embodied a principle borrowed from an English patent of earlier date for the consolidation of peat or coal by pressing it through a cylindrical untapered tube, relying on the friction of the mass in passing through for the resistance necessary to give the required compression to the fuel. M. Evrard used a vertical shaft with a single eccentric or cam acting in succession on a number of horizontal rams ranged radially around it. As these rams reciprocated they allowed portions of the mixture of coal dust and tar (a mixture effected at a temperature of about 300°) to fall before them, which, on the forward stroke, they pressed through the tubes into which they worked and formed the briquettes.

Modifications of ordinary brick machinery having more or less power of giving compression have been extensively used both on the Continent and in Great Britain at different times. These blocks have largely been made of poor Belgian coal, the cementing substance being the pitch resulting from the distillation of coal tar. The materials having been ground very fine and especially well mixed and compressed, the blocks were coked in a muffle furnace for subsequent employment in metallurgical processes. The same plan has been employed extensively in Paris for the manufacture of the artificial charcoal called Charbon de Paris—a substitute for wood charcoal made from charcoal dust of peat and wood in about equal parts, associated with from 5 to 8 per cent. of pitch, which is, however, volatilized in coking, leaving a hard, dry charcoal block.

According to recent information,* the Blanzy Company was the first in France to make briquettes, their works commencing in 1845. The original plant consisted of hydraulic presses by which only one briquette was made at a time. Tar was used as the agglutinant, and the product had to be passed through drying stoves for the purpose of giving it consistency. New methods of mixing and increased facilities for large production rendered new machinery necessary.

The plant now employed consists of two factories, one having three Révollier presses and the other four Biétrix presses. With the Révollier presses the method of manufacture consists in taking the coal dust containing 14 to 15 per cent. of water from the draining tanks of the washing house and tipping it into a pit, from which it is raised by buckets to a hopper in the upper part of the works. From another pit dry pitch is raised in buckets to the same hopper. The buckets are so arranged as to deliver 9 per cent. of pitch to 91 per cent. of coal. After being mixed by passing through endless screws, the coal and pitch is "pugged" for eight or ten minutes in a pug mill. The mill is jacketed with superheated steam. The mixture then falls into the moulds, and is compressed by means of hydraulic rams, averaging from 142 to 156 lb. per square inch. This lasts about half a minute, and leaves only 4 per cent. of water in the briquette. After compression the patent fuel is left on a haulage chain for 40 minutes, when it is ready for loading. The three machines produce 240 tons daily.

With the Biétrix presses the coal, before being pressed, is dried to remove the large quantity of water which it contains. The coal and pitch are mixed in definite proportions, and carried by endless screws into a revolving reverberatory furnace. The mixture, after turning round from 8 to 16 seconds, is taken by an inclined creeper to the pug mill. It now contains from 6 to 8 per cent. of water, which is further reduced by the press, the pressure being 2,300 lb. per square inch. Each press makes 22 to 23 briquettes per minute, or an aggregate for the hour of 330 to 340 tons daily. An auxiliary press makes round or "cannon ball" briquettes.

The Biétrix presses only make one briquette at a time. The coal and ground pitch are raised by a Jacob's ladder to the upper floor of the factory, and each of them tipped into separate hoppers, two for the coal and one for the pitch. These hoppers deliv[illegible] rotary distributors, with recesses, moving at va[illegible] speed, and the proportion of pitch varying from [illegible] 9 per cent. The distributers deliver on to a [illegible] screw, which in turn delivers on to the middle of a [illegible] end endless screw, conducting the mixture into a reverberatory furnace with revolving sole, the two presses being fed by an arrangement of distributers, hoppers and endless screws. The mixture is delivered in the center of the furnace, where, owing to the rotation of the sole, it is seized by a mixing arrangement which stirs it while pushing it from the center toward the circumference. After remaining in the furnace from 8 to 10 seconds, the mixture both dried and heated falls into an inclined creeper, which raises it to the pug mill or mixing machine of the press, where it is subjected to a second stirring or pugging. The mixing machine delivers directly, by an adjustable outlet, on to the revolving table of the press, the recesses of which are filled as they travel underneath. After passing through the furnace, the mixture only contains from 6 to 8 per cent. of water instead of the 13 to 14 per cent. which it contained before. In order to regulate the pressure, the beam crosshead is articulated to a piston working in a hydraulic cylinder with valves. The press thus makes per minute from 22 to 23 briquettes, of a weight varying from 84 lb. to 87 lb., which are received on carriages and carried to the loading place. Rope haulage is often used to lead the briquettes directly to the shipping station.

There are numerous methods in use for the manufacture of briquettes, founded more or less on the description of presses employed. In France the principal types of press employed are those known as the Révollier, the Biétrix and the Zimmerman-Hanrez. As originally constructed, the Révollier presses made cylindrical briquettes; but, during the last few years, as much with the object of increasing the production as for giving the products a greater facility for stowage, the moulds have been modified so as to produce rectangular briquettes. The dusty slack, from 0 to 9 millimeters, brought from the draining tanks of the briquette washing floors in 20 cwt. wagons, is tipped into a pit and raised by a bucket chain to the upper floor of the works, these coals containing from 14 to 15 per cent. of water. A bucket chain placed opposite the former brings to the same hopper the pitch, broken by a Carr disintegrator. The dimensions of the buckets of the two chains, their number and their speed, are regulated so that the proportion of pitch shall be about 9 per cent. The mixture of coal and pitch passes from the hopper into an endless screw, which, after a preliminary mixing, distributes it to other endless screws, directly feeding the pug mills or mixing machines, which, about 8 ft. 6 in. high, with an internal diameter of 3 ft. 2 in., are steam jacketed and provided with an injection of superheated steam. After a mixing of from 8 to 10 minutes, the mixture falls through a movable door onto the mould that is being filled, where it is spread out and leveled with a shovel, the filled mould then passing on to be compressed. Large pumps are used to subject the water to a pressure often of 600 lb. to the square inch, and finished by that of small high pressure pumps, by which the water is subjected to a further pressure of 5,700 lb. per square inch, which, with a total effort of 540 tons on the hydraulic piston of 18 inches diameter, produces on the briquette a pressure of 142 lb. to 156 lb. per square inch. One of these presses can make from 8 to 10 tons per hour.

The formation of fuel blocks by the admixture of tar with small coal has the drawback of increasing the amount of smoke developed, as well as the disadvantage of a certain amount of disintegration which takes place in the furnace as the binding substance melts. It has, therefore, been from time to time proposed to substitute for bituminous matter glutinous, farinaceous, or starchy materials, and several patents have been taken out with this view. The first practical application of the plan is said to have been made under Barker's patent by the London Patent Coal Company, at Northfleet, and the system adopted was described by Mr. Bassett, C.E., about thirty years ago, before the South Wales Institute of Engineers. The small coal was tipped from the wagons into a chamber the bottom of which fell toward the center, whence it passed into a disintegrator and was reduced to one uniform size. It then entered a pug mill, into which was fed a continuous and regular supply of mucilage to be thoroughly mixed with the coal. This mucilage was composed of about 8 lb. of farina (potato starch) and 1 oz. of carbolic acid; the whole was mixed in about 25 gallons of boiling water, and resulted in a paste or liquid glue. The above quantities gave sufficient adhesive compound for the formation of a ton of artificial fuel, at a cost of about 1s. 2d. for the ingredient. After mixing, the blocks were formed in a brick or other moulding machine, and required from 9 to 12 hours to dry in a chamber heated uniformly to 300°. The advantages claimed for this fuel over that manufactured with pitch were that it gave considerably less smoke, and that there was no loss of efficiency in the furnace due to disintegration, as the action of heat tends to harden, instead of to soften, the farinaceous cement. On the other hand, the process was more costly than the ordinary one, in consequence of the cost of the mucilage and of the drying operation. When it becomes necessary to carry with more or less care and to pile in some order so low-priced an article as common fuel, the expense of such operations tells heavily upon profits, and the construction of chambers large enough to hold 50 or 60 tons of fuel spread out for drying is no inconsiderable item, to say nothing of the cost of maintaining them continually at a temperature of 300°.

At a briquette factory recently built in connection with the Fröhliche Morgensonne Colliery, near Wattenscheid, Westphalia, the slack is tipped into a storing tower, from which it is led to the point where its mixture with ground pitch is effected. The mixture is then led to a distributing hopper, and thence into two directly fired heating ovens. After the mixture has been thoroughly warmed, it is led to the Couffinhall presses, which produce briquettes weighing 6½ lb. to 11 lb., three presses turning out 175 tons of briquettes in a day of 10 hours. The larger briquettes are chiefly used for firing marine boilers and the smaller for those [illegible] ...ployed, [illegible] briquettes. Seaweed boiled down in water may be very advantageously used by colliery owners whose works are situated near the coast. The weed on being boiled for some hours produces a glutinous mass, and acts as a good binding material; it should be mixed with the coal dust in the pan. Pine sawdust, 7½ per cent., mixed with the coal dust before going into the pan, improves the quality of the briquettes. Any kind of sawdust may be used, but pine is the best. The quantity of each binding material necessary can be best ascertained by experiment, and presents no difficulty.

* Paper on the briquette factories at the Blanzy Collieries, present[illegible] the Chalon-sur-Saône meeting of the Société de l'Industrie Minérale, [illegible] Dupont de Dinechin.—From the Iron and Coal Trades Review.

REVIEW OF THE PROGRESS OF THE HALF-TONE PROCESS IN THE YEAR 1896.*

By Count VITTORIO TURATI, Milan.

THE last year has enormously contributed to the extraordinary progress of half-tone processes in recent years, though the end of it shows an undoubted standstill in research and advance toward perfection.

Apart from the numerous very immaterial experiences published, we need only consider here those results of general interest.

SCREEN WORK.

Commencing with screen photography, we must state now, as before, that among the many screen systems prepared and tried, the cross line screen—with equal thickness of line and spacing—maintains its high place always with advantage, and enables the best and surest results to be attained.

A multangular screen which has been suggested, consisting of two line systems, moving one on the other, has offered no special advantage in practical work. On the contrary, it makes the work more difficult for the operator by the detailed manipulation requisite.

The many proposed grain screens, also, do not fulfill the promises which we long anticipated of them. They give always coarse prints with raggedness in the fine details, and the numerous attempts to substitute the screen by direct transfer from a coarse grained collotype plate has likewise, from easily conceivable causes, not led to any practical results. On this subject we can best acquaint ourselves by reference to an article published not long ago by A. Albert.†

The new four line screen of Levy gives—as shown by samples kindly sent to the author by Mr. Levy himself—very excellent results. By reason of two of the lines of the screen system being much finer than the other two, we obtain (with correct exposure and treatment) only one dot in the high lights, whereas in the shadows two dots appear in the same area. This solves a problem on which many investigators have worked for several years, a solution built up on the fundamental principle of the chemical correction.

This interesting four line screen is, however, very difficult to produce in large sizes, the cause of which is, as can be readily conceived, that the four line system has to be brought to an exact mathematical correspondence, which imposes a truly enormous task on the excellence of the machines used and the skillfulness of the manufacturer. It is nevertheless to be hoped that the well proved genius of Mr. Levy will overcome the above named difficulties.

On the principles of using the screen and stops, much has been written this year, but all these articles have advanced nothing on the fundamental work of the previous year, 1895, or at any rate very little that is new. The method of focusing for the screen distance, first proposed by the author, has proved in practice exceptionally successful.

The treatment of the collodion negative should be, as far as possible, conservative; the chemical correction is, however, a safe and sure auxiliary means of making faultily exposed or developed negatives useful.

To correctly work after Eder's rules, which are built rather upon a theoretical foundation, presents too many difficulties to the practical operator. Unfortunately this holds good up to the present day, but the time may not be far distant when better craftsmen will make themselves so acquainted with the principles of optical focus that it will be absolutely without difficulties to them. The above mentioned articles are recommended for study, especially the treatise on screen distances (Atelier des Photographen, 1896, page 191). The author has brought his own photographers to this standpoint already.

PROCESS PLATES.

Dry plates on the market for screen work include several makes which are useful, but have not, owing to various disadvantages, popularized themselves generally in practical work; therefore, a really good plate would be acceptable to the professional worker.

Such a plate should show at least all the qualities of a wet collodion plate, and this has been attained already by the author, by a particular method. Professionals like Collardon, Aarland, Perutz, Hemsath, etc., have spoken in the highest praise of the quality and power of this new plate. Active preparations for its manufacture on a large scale, which presents no slight difficulties, are being made.

Relative to the preliminary experiments it may be stated that a large and peculiarly constructed machine has been built, which is already giving very good results. It is anticipated that next year—as building must be done—the production of these plates on a large scale will be carried out.

The Turati plate is a stripping plate, the stripping being done directly after flowing on a leather collodion.

A NEW PRINTING PROCESS.

The following is a printing process which permits of ordinary transfer, not reversed or stripped negatives (being thus especially suitable for half-tone dry plates):

We copy on a bichromated gelatine paper, which is developed in the ordinary way in warm water, and transferred to the polished metal plates. By burning in, the picture is hardened into an enamel, the paper carbonizes and the etching can be performed in the usual way.

The author has published an article on the chrome [illegible] ...ting processes, in which a good deal is said on [illegible] of the colloids; among other things, that

* [illegible] ...ac Year Book.

† "Photographen Zeitung," 1897, page [illegible].

gelatine putrified, respectively by means of acids or alkalies, and thus rendered soluble in cold water (metagelatine), is qualified in a high degree as a substitute for the inconstant fish glue.

ETCHING PROCESSES.

As regards the etching processes, the enamel process still maintains the foremost place. No other process, as regards beauty, freshness and brilliancy, surpasses the enamel etching. The quality of the results is not only due (as is generally believed) to the solidity of the enamel on the copper, but to the gradual penetration of the etching through the enamel film. This is for the most part the cause of the wonderful softness of the results obtained with it. The author first directed attention to this in an article on "Through Etching by the Enamel Process," describing a matter which had not been noticed before.

The author has also found that zinc which is crystallized and structurally changed by heating can be etched very well in specially prepared etching baths. Until now, the burning-in process has been regarded as impossible with zinc, because the ordinary etching baths have an insufficient and extremely irregular action on the modified zinc, and give therefore only rotten and coarse results. But we can, by using a mucilaginous preparation while etching with sedimenting acid solutions, etch even the most crystalline zinc deeply and smoothly. The acid proportion may be thereby very much higher, enabling us to execute a half-tone etching by this new method to the greatest perfection in two to three minutes. This new method offers besides the utmost safety and facility for the etcher.

The so called "cold enamel" processes, founded mostly on the employment of formalin and other mediums, before and after, have not proved satisfactory in practice, as might have been foretold.

RETOUCHING HALF-TONES.

Before closing, a few notes on retouching will not be out of place.

The negative retouching is as good as entirely suppressed. The main point is to secure properly prepared originals. For vignetting, clever operators use optical tricks only. They close the highest lights simply by using a suitably large stop, thus saving the retoucher the troublesome and time wasting stopping-out. If we are not well acquainted with this method, we can also do it by a short after exposure on the original without the screen interposed.

As to the retouching of the plates, we may mention only the interesting discussion developed at the commencement of this year, on the merits of pure half-tone and retouching in the woodcut manner. Without saying more, it is clear that with both methods, in the hands of clever people, excellent work can be produced, while on the other hand, botchers will produce in either case only bad and insignificant work. At all events, the pure half-tone process has arrived to-day at such a high state of perfection that such hand work, besides rendering an increase in price necessary (and there can only be found an excuse for it in certain subjects), is not now required. To-day, when on every hand—even in Japan—excellent work in half-tone photography is accomplished, it is a matter of surprise that it should be thought necessary to resort to such meretricious aids for producing satisfactory work. It is now, moreover, quite clear that this has been only an attempt to put out a lifeboat to save the mediocre wood cut from disappearance altogether. The time which has elapsed, although short, has already shown that this attempt has been futile.

MOUNTING AND FINISHING.

The router and modern machinery for mounting blocks have proved successful and readily find the widest utilization. Of course, such machines can only be employed in large, well founded establishments, being mostly imported from America and very expensive.

For large editions it is always best to face the blocks with copper or respectively with nickel. This is not difficult by galvanic means. Recipes for coppering the blocks with a simple solution are old and consist of an ammoniacal cyanide solution of copper. Nickel recipes of a similar nature also exist, but have been kept secret until now. The use of cyanide has its great inconveniences, however, and the author has studied methods of avoiding it entirely; in his atelier zinc blocks are now copper and nickel faced by means of quick acting, inexpensive and not dangerous baths.

PRINTING HALF-TONES.

So much on the production of half-tone blocks. As to the printing of the same, very little new is to be said. A good overlay, or better still, a well executed photo-mechanical relief overlay, is always necessary.

Very beautiful effects can be produced with tint printing. This tint can simply be smooth, or preferably from a prepared plate, under-printed in the shadows. The "photo-chemigraph" seems to be founded on a similar principle—a process which gives very beautiful results.

Experiments done by the author by over-printing single but opposite lined half tone blocks have rewarded him with very excellent results. One block is first printed in a pale tint, and then the other in a soft intense illustration color. The blocks should be produced by the isotype process, and be of exactly the same size; the dotting must be very exact to avoid disturbing patterns.

A COMPARISON IN THE METHODS OF WORKING BRASS AND ALUMINUM.

ACCORDING to the new price list of the Pittsburg Reduction Company, which went into effect on October 15, it will be seen that aluminum sheet, even in small quantities, is cheaper than brass if the fact of the difference in specific gravity is taken into consideration. This great reduction in the price of aluminum sheet will undoubtedly cause a very material increase in the demand for aluminum to replace brass, and a few suggestions regarding the relative methods of working brass and aluminum may prove of interest.

To commence our comparison, let us take up the question of what changes the manufacturer would have to make, who is now spinning articles of brass, in order that he could substitute aluminum in these same articles. The only real change that is necessary is a change in the lubricant used, as the lathe speed is practically the same as well as the tools; only a lubricant of vaseline should be used on aluminum instead of the ordinary lubricant which is used in spinning brass.

After a little spinning has been done, and the spinner has been able to determine the rapidity of "flow" of the metal, he will be able to handle it more quickly and easily than brass, for the reason that, with but few exceptions, aluminum sheet can be furnished of the proper temper to start with, so that when the article is finished it will be as stiff as it is possible to handle it. Whereas, in brass, if very much work is to be done on the metal, it is generally found necessary to anneal the brass between the successive operations of spinning in passing from one chuck to another. Thus time and labor are both saved in the spinning of aluminum goods.

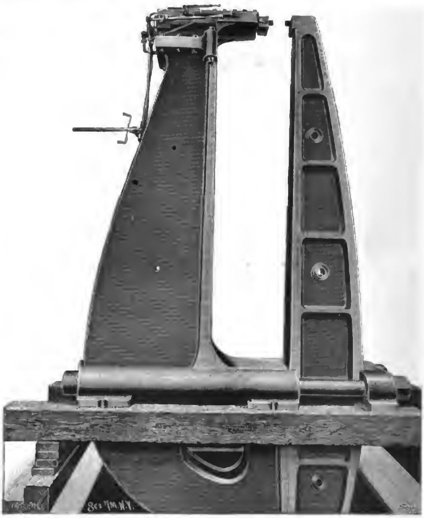
The same holds true in a comparison of spinning copper and aluminum, so that it can positively be stated that people having factories and machinery, and who are now manufacturing brass goods, can change the output of their plant to aluminum with practically no change in the machinery, and can make the articles they are now making out of brass out of aluminum in the future at a less cost, to say nothing of the money which would be saved by nickel plating where it is necessary.

In regard to a comparison of the stamping of copper and brass goods with aluminum, very little difference exists in the way of working these three metals. It would be well to note, however, that where one is using very thin aluminum sheet in the drawing press, the bottom of the male die should be so rounded that it will not cut or tear the sheet, which change can easily be made in any die at little or no expense. The lubricant in this case should also be vaseline, and not the oils or soap and water used on brass and copper.

Some factories to-day, that are both spinning and stamping aluminum goods, make the statement that they pay their men by the piece, and that they make more money and would rather handle and manufacture articles of aluminum at the same rate per piece than they would of any other metal. In regard to the drawing of very heavy sheet in presses, where it is only drawn in one direction, better results will be got by drawing the metal across the grain and not parallel to it. Aluminum, while of a short fiber, has a distinct one, similar to steel, running the length of the sheet.

A comparison of working brass or copper and aluminum on the lathe is also partically identical with all three metals. The greatest change here that has to be made is in the lubricant. For lathe work, or where any drilling or cutting is necessary, the best lubricant to use is coal oil or water. Coal oil gives the best results. Quite a large class of work, however, is performed dry, with excellent results. In some lathe work, such as the cutting of fine screws, etc., it may be found advisable to decrease the speed of the machine from the speed which would be used in turning brass, until the working of the metal is entirely familiar to the person handling it. After the particular peculiarities are established, which all metals possess to a greater or less extent, it will be found that aluminum can be worked in all cases more efficiently and rapidly than brass.

In starting a line of experiments with aluminum, however, it would be advisable to inquire particularly as to the relative merits of the alloyed sheets of aluminum and pure metal. In the majority of cases where aluminum fails to answer satisfactorily the purpose for which it is endeavored to be used, it is because the experiments have been conducted with the pure metal, whereas alloyed sheet should have been used. Pure aluminum compares with the alloys of aluminum exactly in the same way as pure copper compares with brass, and with but few exceptions, such as where electrical conductivity comes into the question or the effect of acid on the metal, is copper ever used; brass being considered the more desirable on account of its cheapness, as well as its greater strength and its general advantages. While the price of pure aluminum and the alloyed sheets of aluminum is the same in the majority of cases, it is found more advisable to use the alloyed sheet.—Aluminum World.



HYDRAULIC RIVETER.

LARGE HYDRAULIC RIVETER FOR LOCOMOTIVE BOILERS.

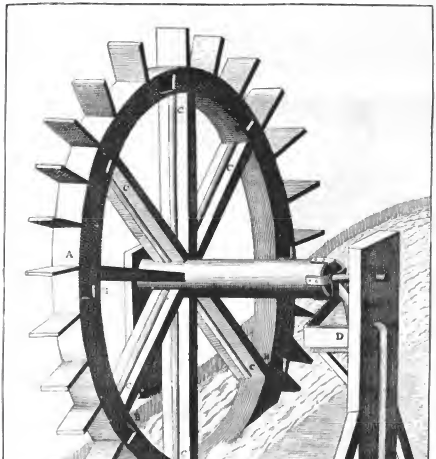
THE illustration above shows a long gap stationary riveter, specially designed for riveting a complete boiler shell at one plating. It has a gap of 16 ft. 6 in., and exerts a pressure of 50 tons upon the rivet. The main body is of cast iron of heavy box section, while the hob is of open section mild cast steel. The two are held together by a pair of very strong through bolts, having a large margin of strength to prevent any yielding under the pressure of the ram, so holding the hob very rigidly up to its work. The riveting head is bolted loose upon the main standard, and has a long projecting beak which permits of a steam dome being riveted to the boiler barrel by the machine. To enable the rivet snaps to get more closely into all corners, the cylinder slide and the top of hob are fitted with snap holders having six sockets—two right, two left hand, and two central, in two rows, one above and one below. By this means the machine is enabled to get at every rivet in a locomotive boiler or firebox, with the exception of one row in the top of the latter,

which, however, can be riveted by a special appliance if desired. The cylinder and slide are in one mild steel casting, bushed with gun metal and provided with large planed guide surfaces. The slide is held down in its guides by a pair of planed steel bars secured by set bolts. Great economy of water is secured by a special arrangement of water-saving gear, which causes the slide to be run out until the snap touches the rivet, the cylinder meanwhile being filled from an overhead tank. As soon as the snap touches the rivet, pressure is admitted to the cylinder to complete the operation. We are indebted to the London Engineer for the cut and copy.

MACHINE FOR RAISING WATER FROM A RIVER TO THE HEIGHT OF THE HALF DIAMETER OF A LARGE WHEEL.

The fellies of the large wheel, A, must be so constructed that they shall be hollow within, and that, being separated from each other, they shall form so many boxes capable of filling with water in passing into the river. To this effect, an aperture is made in them at B, that is to say, at that part of each felly that rises first when the wheel revolves; and, in order to cause them to raise water to where it is desired, there is also formed in them apertures at C into which are fitted pipes that extend along the spokes of the wheel, and then along its axle, and end in the reservoir, D, into which they empty the water from the compartments of the rim in measure as they rise above the half diameter of the wheel.

As the current of the river causes the wheel to revolve through the paddles with which its rim is provided, the fellies of the latter succeed each other continuously, take up water from the river and carry it in abundance to the height that has been proposed, that is to say, to the reservoir, D, which is at the level of the half diameter of the large wheel, A.—From Recueil d'Ouvrages Curieux de Mathematique et de Mécanique.



MACHINE FOR RAISING WATER FROM A RIVER TO THE HEIGHT OF THE HALF DIAMETER OF A LARGE WHEEL.

Owing to the death of William L. Winans, the American millionaire, who died on June 25, his two "cigar" yachts, which have been moored in Southampton Water for twenty-five years, will be sold. Enormous sums of money have been spent in experiments upon them, but few people have seen them under way.

THE COMMERCE OF THE GREAT LAKES.*

By Charles E. Wheeler.

The disastrous panic of 1893 was not without its benefits. It not only revealed the necessity of a reform in our monetary system, a lesson as yet blindly unheeded by the nation, but taught as well the need of industrial economies, and along this line most commendable progress has been made. During the past three years every manufacturer's office has been a school room, whose instructor has been Necessity, and the lesson that of applied economies and cheaper production. Mr. Carnegie, for instance, was an apt student and learned the lesson quickly. He built a railroad from the south shore of Lake Erie to his furnaces on the Monongahela and cut the rail carrying charge in two. He went beyond that. Availing himself of the dilemma of Mr. Rockefeller, possessed accidentally of several large deposits of ore on the south shore of Lake Superior, he was able to place himself in a position as regards ore supply to compete with the world, at the same time lowering the transit cost of the ore from the mine to his railroad. Mr. Rockefeller in turn saw meager profits, unless, availing himself of the deeper channels furnished in recent years by the government, he had larger boats to carry his ores than have been running in the trade. He built a dozen of them, and thus it happened that more than half of all the steel tonnage in the merchant marine of the United States built in 1896 was the product of our lake shipyards, and surely our pride in that we now own more than half of the merchant marine of the United States, as regards boats of 1,000 tons burden and over, is quite pardonable.

Everywhere, less noticeable because on a lesser scale, the same trend toward the same end is to be found. It has not received the attention it deserves—the constant, determined, intelligent effort of the American manufacturer, during the years of financial trial, to open new markets, stop wasteful expenditures, cheapen production. With returning prosperity he is rash who will set limitations on American trade abroad or at home—a result of the discipline of 1893-94-95. The growth of our export trade in the iron list is unmistakably genuine, recognized and frankly acknowledged by English competitors. The Duke of Devonshire, at the meeting of the Barrow Company directors, spoke of it as "alarming." The London Times, commenting on his declaration, marvels at the magnificent scale of operations at Homestead, where it finds furnaces each producing 200,000 tons of pig iron per annum, the average capacity of the English furnaces being less than 24,000 tons per annum. During the last month or two rails for Liverpool have been coming to tide water all rail from the Cleveland district. Nails and wire rods have been going abroad in generous quantities. The future is full of hope, if unwise legislation does not create more artificial barriers than the ingenuity of the American manufacturer can overcome.

Contributing to this happy condition of affairs, the cheap transportation on the lakes has been a factor of prime importance. The transporting interests on the inland waters have not failed to meet the new situation with intelligent effort and splendid courage. It was inevitable that cheaper transportation should come. The 20 foot channel from Duluth to Buffalo is practically completed, and the invitation to larger boats and cheaper rates could not be denied. Besides, the traffic itself is of such magnitude as to compel a minimum rate. Over that course of commerce must come the nation's breadstuffs, its lumber, its iron ores and copper in quantities that pass comprehension. The figures for 1897 are, of course, not yet complete, but there is little doubt, if any, that the most prosperous year will be equaled, even surpassed. If this proves true, over 28,000,000 tons of freight will have passed through the Detroit River in 1897. Load that freight in cars, 20 tons to the car, place the locomotive at New York, and the caboose will be in New York as well, but between the two nearly 2,000,000 cars will be found, extending across the continent to San Francisco, back again to New York, again across the continent, again back to New York. It is a greater commerce than that of Liverpool or London, foreign and coastwise, greater than both combined. It exceeds the total entries and clearances in the foreign trade at New York, exceeds the total of like entries and clearances at all the seaports of the United States. I am speaking of quantities, of course, not values.

Imagine, if you can, the uses to which the freight is put, the industries it nourishes. Sixty-six per cent. of all the ores used in the United States comes through the Sault, and, notwithstanding the bright outlook and flattering showing made by the Alabama and Tennessee district, the percentage of the total amount of ores used is not only markedly in favor of the Superior ores, but the percentage increases year by year.

Two-thirds, then, of all the ores used in this country come from the south shore of Lake Superior, and are the sole source of supply of such mills as those of the Carnegie Company, the Illinois Steel Company, the Johnson Company, the Cleveland Rolling Mill Company and others that are now confessedly equipped to compete for foreign trade. If our hope in the future supremacy of the American iron and steel maker is well grounded, surely we may look for its justification in the furnaces between Cleveland and Pittsburg. There, if anywhere, must be found the means by which in an iron age this country may assume a commanding position in the iron markets of the world.

And the whole matter depends on cheap transportation. Remove the chain of lakes, and no railroad or system of railroads could hope for a moment to place the 140 different iron and steel manufacturers in the Central States district in a position to compete with foreign mills, and in the catastrophe thousands of allied industries must inevitably be abandoned. For the coal for the coke is in western Pennsylvania and the ores over 900 miles away. No railroad in America is better equipped to transport freight cheaply than the Lake Shore and Michigan Southern. Its grades are light, its tracks and roadbed unsurpassed. The cost per ton mile in 1896 on that railroad was 3·81 mills; the cost on the lakes 0·89 mill. We have this year reduced the latter figure fully one-third in the operation of the larger boats. We have been bringing ore from the south shore of Lake Superior to Cleveland at a rate of but 15 cents per ton over the ordinary railroad switching charge in any of our large cities. We have been taking coal back at one-third the New York lighterage rate.

To reach such results has demanded the most rigid regard for economies in every direction. It has worked a revolution in loading and unloading cargoes. It became necessary that appliances should be such that 6,000 tons of ore could be loaded into a boat, the boat trimmed and ready to depart for her eastern terminus within four hours after tying up to the dock. It became necessary that at this end of the line those 6,000 tons should be unloaded in ten hours. It became necessary that 40 cars an hour, each car containing 25 tons of coal, should be lifted up bodily one at a time, and the contents discharged into the boat as easily as a laborer flips his shovel.

When Mr. Carnegie amazed the world last spring with his low quotations and other mills followed, let it not be forgotten that it had been impossible but for our shipyards, the genius of the mechanical engineer, and our steamship organizations, which have availed themselves of every known appliance for the economical conduct of their business. Had it not been for them and the lakes, Mr. Carnegie had sought in vain for his foreign market, Mr. Moxham had returned from Liverpool empty handed, and the Cleveland rod and nail mills had never dreamed of Japan and England for profitable sales. The commercial supremacy of America in iron and steel manufacture is impossible but for the great lakes.

And now let it not be thought that the greater part of that traffic is the carrying of iron ores. It is nearly a half of the tonnage, it is true, but in value occupies but fourth position. The total value of freight passing through St. Mary's Falls canals in 1896 was over $195,000,000. Of this amount wheat must be credited over $47,000,000; flour, $34,000,000; unclassified freight, $31,000,000. Iron ore with $25,000,000 comes next, closely pushed by copper with $23,000,000 to its credit. If the grain shipments out of Chicago and the lumber shipments from Lake Huron be added, and again there be added the value of the coal and merchandise shipments from Lake Erie to Detroit and Lake Michigan ports, the importance of iron ore in the list is not so readily recognized, and it will be seen that what I have said of the lakes and their relation to the iron industry ap-

* Read at the New York meeting of the Society of Naval Architects and Marine Engineers.

plies quite as well to wheat, corn, oats, flour and possibly copper.

It is almost certain that the indirect effects of lake transportation are of greater importance than the direct. Mr. Blanchard, in his argument of March, 1894, before the Committee of the United States Senate on Interstate Commerce, made a significant and, as I believe, absolutely truthful statement in these words: "I contend," he said, "that after rivers, lakes, oceans and economic forces have spent their combined natural and national powers in determining rates which are reasonable, such rates cannot be made excessive by combination." Mr. Blanchard was defending railroad pools, a question alive to-day and destined to command careful public consideration in the years to come. As a representative of the railroad interests his plea may be that of an advocate, yet the fact is he was entirely correct. No railroad or combination of railroads can dissociate itself from the traffic means we are considering. It is a controlling factor, and if Duluth can ship her flour from that port to Liverpool for 14½ cents per hundred—a privilege she enjoyed for a brief time the past summer—its effect is instant upon every railroad that has flour mills to protect or grain to haul to them. And then, too, it is not iron ore, flour and wheat that alone monopolize the low rate. The class freight annually carried over the lakes between the great commercial centers, Chicago, Milwaukee, Detroit, Toledo, Cleveland and Buffalo, and beyond in connection with the rail lines and the Erie Canal, is an item concerning which, unfortunately, no accurate data are at hand, thanks to a law which does not exact reports of any considerable statistical value; but the fact that all your trunk lines whose western terminus is Buffalo own and operate their own boats, and the fact before cited that the unclassified freight in the Lake Superior trade amounts in value to over $30,000,000 per year, hint at the enormous value of the total class business transacted in the lake trade. None of the trunk lines may ignore it and its influence is far felt. If it became a traffic necessity for the Lake Shore & Michigan Central and the New York Central & Hudson River Railroads to approximate the lake and rail or lake and canal rate on any commodity from Chicago to New York, be sure the other trunk lines will meet it, and give their tide water terminals the same rate, not omitting the differentials. As was the case this summer, even the north and south lines, such as the Illinois Central, must of necessity take a hand, protecting their Gulf termini against the competition thus forced on them. Now, while its effects are of little consequence, perhaps in regard to higher class freight, there can be no question but all the 6,000 railroad stations east of the Mississippi and north of the Ohio River reap a decided benefit in the carrying cost of the lower class freight and commodities; for when through rail rates are reduced between Chicago and New York for instance, because of lake competition, they are simultaneously reduced between intermediate points because of the long and short haul clause of the interstate commerce act. The effect is widespread, often disastrous to the carrier, but at least yields this comfort: That the present unmistakable tendency toward concentration of railroad interests or the enactment by Congress of a law permitting railroads to pool is a menace of academic rather than real interest. So long as our water highways are open, the railroads have a competition that cannot be overcome.

There is another reason why this competition is irresistible. In the building of boats and their machinery, the naval architect and marine engineer may hope reasonably to keep in advance of the maintenance of way engineer, the master car builder and the superintendent of motive power. Walking through the Globe shipyards one day with Mr. Parkhurst, he picked up a piece of coal the size of a walnut and remarked: "You would hardly think that little lump of coal will carry a ton of freight a mile, would you? and yet that is what it will do on our better class of boats." It is true—fifty-five hundredths of an ounce of coal per ton mile is the record.

Now, such results are not to be expected in the performance of a locomotive; at least they are not in sight. Such economies are associated with triple and quadruple expansion engines, and it is worthy of note that, for the first time in the history of shipbuilding in America, we on the lakes are now building our freighters with quadruple expansion engines. Then, too, our waterways are being deepened, our boats enlarged. Until last year they were less than 400 ft. long. We are now building them 475 and 500 ft. in length over all.

There is in a workshop at Cleveland an internal combustion engine, built for the company with which I am associated. It weighs about two tons, and is, if I mistake not, the first compound gas engine that successfully meets all requirements. Its cards show an indicated horse power of 111 and a thermal efficiency of 39·5. Making no claim whatever to a technical mechanical training, I am perhaps treading on dangerous ground, but this at least is known: That reduced to steel strains we have an engine of 92 horse power per ton, a record far surpassing that of the Turbinia, an engine that exhausts at atmosphere and that may be built to any power if some of your own brightest marine engineers are not in error. In any event, it is certain the principle of a compound gas or oil engine is now thoroughly understood, and whether the present device fulfills expectations or not, assuredly the time is not far distant when important results will come from the untiring efforts of mechanical engineers to transfer the source of power from the boiler to the cylinder. I mention it because indicative of a possible revolution in mechanics that will work economies in the engine room of a vessel impossible to the locomotive, and thus increase the already marked difference between the cost per ton mile by water and that by rail.

Clearly we have not yet sounded the possibilities of cheap transportation by water, and with their discovery one may be justified in believing that their application can nowhere be productive of more beneficent results to mankind than on those waters to which are annually consigned the products of the vast plains of the West, the nation's food and the supply of her workers in iron.

London has 196 inhabitants for each square kilometer, Paris 365, Rome 290, Turin 340, Naples 169, and in her Pendino quarter 1,254.

A GALLANT REGIMENT.

THE storming of the heights of Chagru Kotal has been justly described as one of the most stirring feats of war in Indian army annals. The story of the fight reminds one of "The Drums of the Fore and Aft," for it was the Highlanders and the Gurkhas who saved the day. The Gurkhas, it will be remembered, led the attack, and succeeded in getting into shelter inside the line of fire of the tribesmen, who were strongly posted on the hills. Next came the Derbyshire and Dorsetshire regiments, but the hail of bullets made them fall back. Then Col. Mathias called on his Gordon Highlanders. "Men of the Gordon Highlanders," he said, "the general says that the position must be taken at all costs. The Gordon Highlanders will take it." With the bagpipes rousing echoes in the hills, the men leaped to the attack and carried the positions in superb style. During this splendid rush Lance Corporal Piper Patrick Milne was shot through both legs, and he was brought helpless and bleeding to the ground, exposed to the deadly fire of the enemy as he lay in the bullet-swept zone. Milne, if not quite the first to leap into the zone, was among the first party of Highlanders. As he ran, he piped lustily the "Cock of the North." When shot down he managed to get himself into a sitting position, and with gradually diminishing vigor continued to play. But he was only one of five Gordon pipers who won praise by their pluck at Chagru Kotal. The other four sturdily marched across the zone fire, piping all the way. Only one got across unhurt. Three of them were wounded, one of them severely. Lance Corporal Piper Patrick Milne is an Aberdeenshire man hailing from Insch, where his

LANCE CORPORAL PIPER PATRICK MILNE.

father was a farmer. At the age of nineteen he enlisted at Aberdeen Barracks, and sailed for India in 1893. When he had been two or three months in India, Milne received his first good conduct badge. While at Sabatha he joined the pipe band of the regiment. He was with the Gordons through the Chitral campaign, and had then a wonderful escape. While playing his pipes a bullet struck the pipe bag within an inch of his side, rendering the pipes useless, but doing him no injury.

The First Battalion of the Gordon Highlanders, the old Seventy-fifth, was raised in the Highlands in the year 1787, but the Highland dress and title were discontinued in 1809, as there were not more than about a hundred Highlanders in the regiment. In 1862 it was given the title of Stirlingshire. Afterward it was linked with the Thirty-ninth Regiment. In 1881, on the introduction of the territorial system, the regiment reverted to its original position as a Highland corps, and became the First Battalion of the Gordon Highlanders. The First Battalion of the Gordons as a new Highland regiment soon won the respect and admiration of the rest of the Highland Brigade. At Tel-el Kebir the First Gordons did splendid service, and for their conduct at Teb and Tamai they were highly praised in Sir Gerald Graham's dispatches.

A detachment of the regiment fought at Abu Klea and Gubat. In 1885 the regiment was again on the Nile, but had all the unpleasant work of campaigning and none of the fighting. Last year it took part in the Chitral campaign, being present at the taking of the Malakand Pass. Thus, since 1882, the First Gordons has taken part in four campaigns, assisted in six pitched battles, and is now engaged in a fifth campaign. We are indebted for our cut and particulars to the London Graphic.

SELECTED FORMULÆ.

A peculiar fabric, which may find employment for many purposes, is made in Brussels. It is flexible, transparent and impervious to water. This textile material can be washed off with cold water, like a glass pane, by means of a sponge, and is mainly to be used for portières, window shades, umbrellas, etc. The patented process for the production of this tissue consists in filling up the meshes of a wide-meshed fabric, such as muslin, etc., with chrome gelatine or with a similar material, and then rendering the chrome gelatine insoluble by exposure to light. The fabric is then coated on both sides with boiled linseed oil or fat varnish. The treatment with chrome gelatine and linseed oil is repeated several times, and the fabric is ornamented by printing.

Spontaneous Combustion of Resinified Minium.—According to Prakt. Maschin. Konstr., resinified minium is subject to spontaneous combustion, as was proved by a fire caused by minium at a factory the other day. The hardened contents of a barrel of minium was broken up for the purpose of regenerating, and covered with bags overnight. The action of the oxygen of the air upon the fresh fractures of the hardened minium caused a development of heat in the same, under reduction to lead and ignition of the admixed varnish resins. Only by the vigilance of the factory watchman, a large accident was narrowly averted.

Red Ink.—

(1)	Carmine, No. 40	30 grains.
	Ammonia water	1 drachm.
	Acacia	6 grains.
	Water, q. s. to	1 ounce.

Dissolve the carmine in the ammonia, and add the other ingredients. The depth of tint may be varied by the use of more or less water.

(2) Half a drachm of powdered drop lake and 18 grains powdered gum arabic, dissolved in 3 ounces ammonia water, makes one of the finest of carmine inks.

White Ink.—White ink is made by suspending some insoluble substance in a liquid and applying with a brush or pen. In this way zinc oxide (Chinese white) may be ground very fine on a slab with a little mucilage of tragacanth, then thinned to the required consistency to flow from a pen. The mixture requires shaking from time to time to keep the pigment from separating. The ink may be preserved by adding a little oil of cloves, carbolic acid, or other antiseptic to prevent decomposition. All so-called white inks for colored papers are made from acids or alkalies which will discharge the color. The following preparation is used for writing on slate colored, blue or red paper:

Slaked lime	4 drachms.
Tragacanth, in powder	16 grains.
Glycerine, a sufficiency.	
Distilled water	4 ounces.

The lime is rubbed with the tragacanth and enough glycerine to make a stiff paste; rub for about fifteen minutes, and then add the water, and bottle.

The following is an ink for a blue paper:

Hydrochloric acid	1 fluid drachm.
Mucilage	30 minims.
Water	7 fluid drachms.

—Pharmaceutical Era.

Liquid for Gold Paint.—Stir the fine metallic powder into copal varnish previously thinned down to the proper consistency with turpentine. (2) Brannt gives the following: Melt dammar with an alkaline carbonate and expose the melted, finely powdered mass for several months to a temperature of about 122 deg. F. The alkaline resin thus obtained is dissolved in a hydrocarbon below 302 deg. F. Any acid contained in the hydrocarbon is previously neutralized by the introduction of dry ammonia gas. The mixture of this lacquer with the bronze powder keeps for a long time. (3) Pour over 100 parts of dammar and a few pieces of glass in a bottle 900 parts of benzine. Pour off the solution from the fine sediment and glass, and suspend in it 300 to 400 parts of bronze powder. Fill in small bottles. A gold paint or varnish may be made as follows: (1) Digest shellac, 16 parts; gum sandarac, mastic, of each 3 parts; gum gamboge, 2 parts, all bruised, with alcohol, 144 parts. (2) Artificial alizarine or garancine is to be digested in a glass vessel in three times its weight of alcohol for twelve hours, and pressed and filtered. A solution of clear orange-colored shellac in alcohol is next filtered and evaporated until it has the consistency of sirup. The latter is now covered with a layer of tincture of garancine, which permeates it. The slight brownish tinge of this varnish—a tinge absent from gold—may be corrected by a tincture of saffron. (3) Pulverize 1 drachm of saffron and ½ drachm of dragon's blood, and put them into 1 pint of 90 per cent. alcohol; add 2 ounces of gum shellac and 2 drachms of socotrine aloes, dissolve the whole by gentle heat. Yellow painted work varnished with this mixture will appear almost equal to gold.—Pharmaceutical Era.

Old Corks can be cleaned by washing with water containing 10 per cent. of hydrochloric acid, then immersing in a solution of sodium hyposulphite and hydrochloric acid. Finally the corks are washed with a solution of soda and pure water, says the Pharmaceutical Era. Corks containing oil or fat cannot be cleaned by this method.

Manure for Flowers.—For hastening the growth of flowers the following fertilizer is recommended. It consists of:

Potassium nitrate	30 parts.
Potassium phosphate	25 "
Ammonium sulphate	10 "
Ammonium nitrate	35 "

Remedy for Locusts.—We give from Revue Scientifique a remedy against locusts, which has proved efficient in Natal: Dissolve equal parts of caustic soda and arsenic in thirty-two times their combined bulk of boiling water. Of this stock solution take one gallon, dilute it up to forty gallons, add ten pounds of brown sugar or sirup. In this solution soak straw or Indian corn stems, etc., and spread on the fields. The locusts, attracted by the sugar, eat the poisoned stems and die, others come and eat the dead locusts and are also killed.

ENGINEERING NOTES.

A diver in the Clyde recently worked for forty minutes at a depth of 186 feet, which is a record in Great Britain.

It is learned that the mammoth pontoon dock which is being built to Spain's order at Stephenson's yard on the Tyne is destined for the Philippine Islands, and not for Havana, as was at first reported. This dock is similar in size and construction to the one recently built and dispatched in tow for Havana.

A cable line has recently been completed connecting Puerto Cavello, Venezuela, with La Guayra, and thus with New York, by way of Curacao, Haiti, etc. A delay of many hours is avoided in the transmission of telegrams which formerly went over the national overland lines.

Consul Duester, at Crefeld, Germany, reports to the State Department a discovery made there which, it is said, will revolutionize the methods of illumination. It is an incandescent gas. A single jet of ordinary size can emit a light of much more than 1,000 candle power, and fine print can be read at a distance of 100 feet. The inventor says the cost for a light of 1,500 candle power is only $4\frac{1}{8}$ cents per hour, while that for an ordinary electric light of 400 candle power is 14 cents per hour.

It is announced that the steamers of the Peninsular and Oriental Company will, after February 1, 1898, call at Marseilles instead of at Brindisi, owing to the niggardly policy of the authorities at the latter port in refusing to extend the local railroad half a mile to the quay for the accommodation of passengers and mails. This action upon the part of the officials of Brindisi makes them responsible for the loss of business involved in the landing there of 110 large passenger ships yearly.

We are informed that, for safety's sake, the receivers of the Baltimore & Ohio Railway have placed out of service nearly all of the old iron hopper cars which have been used on the Baltimore & Ohio for a great number of years. These cars, it is stated, were very weakly constructed, and if put in a train between the heavy modern freight and coal cars of to-day, are very likely to be crushed in case of a sudden stop, or a too strong application of air brakes. Up to September 30, 1,500 of these hoppers had been retired and thrown on the scrap pile.

The use of aluminum bronze is increasing for purposes where a strong and dense metal is required, says The Aluminum World. The amount of aluminum in aluminum bronze varies from a few per cent. up to 10 or 11 per cent., depending on the purpose for which the metal is intended. The strongest mixture contains between 10 and 11 per cent. of aluminum. Beyond this point the bronze is hard to work and becomes brittle. Aluminum bronze can readily be soldered. In soldering this alloy no such difficulty is encountered as is found in soldering pure aluminum. The best method of soldering aluminum bronze is to use pure block tin with a flux made from zinc filings and muriatic acid. It is well to "tin" the two surfaces before putting them together.

According to an article on the "Comparative Fusibility of Foundry Metals," in The American Manufacturer, the economy and advantages to be obtained by using chilled pig metal in foundries and in Bessemer steel works are as follows: First, being a harder iron by reason of its chill, or having its carbon largely in the combined form, as well as having the pigs free of sand, less fuel will be needed to melt it, and it can be made to come down faster in the cupola, thus saving time in melting. Second, the pigs being sandless, there will be needed less fluxing and slagging of a cupola in large heats, and this will also give a cleaner iron out of small as well as large heats from the tap hole. Third, its being chilled will cause it to be broken more easily. Fourth, the general use of chilled cast pig metal would do more to compel the use of chemistry in founding, because those who still make mixtures of iron by judging grades by fracture would be forced to work by analysis, as chilling a pig would more than ever disguise its chemical composition.

The rapid extension of the iron industry in European Russia, through the establishment of the several large new iron and steel rolling mills already erected, or now in course of erection in the country, has called into existence a new branch of the iron business which hitherto depended chiefly on foreign supply, says The Engineer, the construction of plants for the manufacture of iron and steel. New works for this purpose have just been opened in Riga by a company forming a branch of a similar one in Dahlbruch, in Westphalia. The Riga company has secured a well situated piece of ground of $17\frac{1}{2}$ acres, so as to be able to extend its works to fourfold their present dimensions. The buildings and machinery, including a 30 ton crane, are all of the most improved description, and are provided with electric transmission of power and electric lighting. The designs for the machinery to be constructed will be furnished by the parent establishment in Dahlbruch. Germans, Belgians and Frenchmen are taking a firm hold on the iron production business in Russia.

Since the institution of cotton mills at Shanghai, the wheelbarrow has been extensively used as a passenger vehicle, especially for carrying workwomen to and from the mills. One man can wheel six women for a distance of about three miles, morning and evening, the charge being 35 cents per month. The average earnings of a wheelbarrow man are about $8\frac{1}{2}$d. per day. About 4,000 licenses are issued monthly to the same number of wheelbarrows plying for hire in the streets of the foreign settlements at Shanghai, where, being under the municipal regulations, they are perhaps the best in China. Sometimes as many as fifty barrows may be seen in the streets, traveling one behind the other, each carrying two barrels of English Portland cement and pushed by one man. Very frequently a load is carried on one side of the barrow only, and it is extraordinary to see a Chinaman skillfully balancing and propelling it. The upsets and accidents, too, according to [illegible]'s Magazine, are remarkably few, when it is cons[illegible] that about 4,000 of these vehicles are in use in the streets, in addition to a large traffic of other kinds.

ELECTRICAL NOTES.

Letter stamping machines are being experimented with on the trolley postal cars in San Francisco, the machines being run by motors that take current from the trolley circuits.

The street car system of Munich is to be wholly converted into an electric line system within the coming two years. The plant is to be three times as powerful as the one at Berlin, and is to supply electricity for lighting purposes and to private individuals, besides running the cars. Expenses are estimated at two and three-fourths million dollars.—Uhland's Wochenschrift.

Cutting Up Trolley Wires.—Not a month passes, says the Street Railway Review, of Chicago, but we record the loss of trolley or feeder wire which has been stripped from the hangers and is usually found chopped up into short lengths of a foot or two, suitable for melting into pigs to prevent identification. Some months there are several such reports, the losses ranging all the way from a few dollars to several hundred; and occasionally the damage done causes an expense of one or two thousand. The nuisance is not confined to any State, but is "prevalent all over."

From experiments recently made on specimens of iron of different lengths, Mr. Henry Wilde, F.R.S., has found the magnetization limit to be 422 lb. per square inch, or 29·67 kilos. per square centimeter. In his communication to the Royal Society, Mr. Wilde describes an experiment showing that the single pole method of determining the magnetization limit of magnetic substances compares favorably with the double pole method, and that no higher degree of tractive force is to be expected from the latter than has been obtained from the former method.

Under date of August 30, 1897, Consul Germain writes from Zurich: The total length of the world's telegraph system has now reached 7,900,000 kilometers (4,908,823 miles), exclusive of 292,000 kilometers (181,440 miles) of submarine cables. This mileage is apportioned as follows: Europe, 2,840,000 kilometers (1,764,790 miles); Asia, 500,000 kilometers (310,685 miles); Africa, 160,000 kilometers (99,419 miles); Australia, 350,000 kilometers (217,479 miles); America, 4,050,000 kilometers (2,516,548 miles). It will, therefore, be seen from the above that, notwithstanding the steady increase in the building of telegraph lines all over Europe, America leads and has almost double the mileage of Europe.

A novel method of illuminating the new Low library at Columbia University is being tried experimentally, says Electricity. The idea is to gain the advantage of diffusion from a large surface centrally located, and at the same time to be realistic. The plan being tried is as follows: Suspended in the center of the great hall is a large hollow globe seven feet in diameter and painted a dull white. This is not a receptacle of the light intended to diffuse the rays by transmission, but is opaque and intended to diffuse the rays by reflection. Upon this sphere are directed the concentrated beams of light from eight hidden arc lamps located at intervals along the gallery pilasters. The moonlight effect is heightened by the background of blue which constitutes the ceiling, and the effect is described as fine in the extreme.

Some rapid electric railway construction was recently accomplished near Bound Brook, N. J., where $2\frac{1}{4}$ miles of road was constructed in 22 hours, including all grading and overhead line construction, by the New York & Philadelphia Traction Company in an effort to outwit a rival company and prevent the stopping of work by an injunction. The right of way between Bound Brook and Somerville was being disputed by the New York & Philadelphia Company and the New Brunswick Traction Company. The former quietly arranged with J. G. White & Company, of New York, to build the section during the 24 hours between 12 o'clock Saturday and 12 o'clock Sunday nights, says Engineering News. The work required the transportation of 600 men, four cars of tools and provisions, large quantities of poles and ties, lighting apparatus, tents, etc. The work was accomplished, current turned on from a temporary power station built on the property of an interested party, and a car run over the line within the allotted time, notwithstanding the opposition of the local authorities, who were obliged to succumb to the superior numbers of their opponents.

An electrical transmission plant has recently been completed by the Blue Lake Water Company in Alpine and Amador Counties, California, says Engineering News. Ten small lakes between 4,000 and 8,000 ft. above the power station, with a catchment area of about 67 square miles, form the source of water supply. By damming their outlets, a total storage capacity of 20,912,000,000 gallons was secured. These lakes discharge into the Mokelumne River, and at a point about 45 miles from the lakes the water of this stream is diverted into the Amador Canal. This is an artificial channel $42\frac{1}{2}$ miles in length made through very rugged country. There is one tunnel and 82 flumes, aggregating 3·7 miles in length. The canal has a grade of about 8 ft. per mile, which gives a velocity of 300 ft. per minute and a capacity of 3,000 miner's inches. The ditch ends in a concrete forebay and settling basin, which also forms the upper end of the pipe line. This conveys the water a distance of 3,340 ft. to the turbines, with a drop to the point of delivery of 1,242 ft. The pipe is in five sections, which vary in diameter from 48 in. at the upper end to 15 in. at the turbines. Where flange joints were made, $\frac{1}{8}$ in. sheet lead gaskets were used as packing, and these were compressed by drawing up the flange bolts until only $\frac{1}{8}$ in. thick. In a test of sections of 15 in. pipe joined in this way, a pressure of 1,200 pounds per square inch was withstood. To anchor the pipe and prevent mechanical injury, the entire length was sunk to the surface of bed rock, and the last 400 ft. was embedded in concrete in a trench blasted out of the solid rock. Three 700 horse power Doble water-wheels 4 ft. in diameter, with a working speed of 600 revolutions per minute, are directly connected to three Stanley two-phase inductor generators. The power generators give 7,200 alternations per minute, with a voltage which can be regulated from 2,000 to 2,400. An interesting feature is the entire absence of any sort of receiver or air chamber. Notwithstanding the great pressure employed, nearly 560 pounds per square inch, the only protection at present against water hammer is a form of gate which cannot be closed rapidly.

MISCELLANEOUS NOTES.

Is a factory chimney real estate or is it part of the machinery? This question is now engaging the attention of the city assessors of Montreal, on the claim of the Montreal Street Railway Company that their chimney, now assessed as real estate, is really an important part of the mechanical plant, and as such is exempt from taxation. Of the $75,000 expended on the power house of the company fully one-third was used in erecting the chimney. On this point the assessors themselves differ, chimneys being assessed as real estate in some Montreal wards, while they are exempted in others.

The great salt wells at Tsz Liu-Ching, China, is the title of a recent consular report. In the region mentioned no less than 250,000 persons find employment in operating the 5,000 wells and necessary refining machinery. Most of the wells range from 2,000 to 3,000 ft. in depth. They seem to have been bored with a form of hammer drill supported at the end of bamboo ropes. The work of drilling progresses very slowly, in one case progressing only two inches per day, and a well requires many years to complete. The upper or earth section is usually lined with cedar tubing to keep out surface water. From many of the wells natural gas flows, often under considerable pressure. It is used as a fuel in evaporating off the brine. The brine is raised from the wells by a bucket and windlass, the latter operated by buffalo power.

The London Engineering says: "The French manufacturers of asbestos goods are supplied from four sources: 1. Canada, whence the asbestos is white, silky, very unctuous, having supple fibers from 5 to 25 millimeters in length; of all varieties it is that which spins the most easily. 2. Siberia, whence the mineral is yellowish, some species being of a straw yellow. The fiber is less flexible and more woody, but stronger than the Canadian, which it resembles in length; large masses of long fiber mineral being, however, rarer. 3. The Cape of Good Hope asbestos has a characteristic blue color. It occurs in larger masses than either the Canadian or Russian, and its fiber is generally longer and stronger. In spinning or other manipulation, however, it is difficult to handle, a good deal of the fiber being reduced to powder. 4. In Italy there are different kinds of asbestos, but generally they are little adapted to spinning. There are some long silky fibers of little resistance, employed for gas furnaces; others are very short and fit only to make heat-retaining coverings."

The best aluminum alloys have about 16 per cent. less strength and rigidity when drawn into tube than a steel tube of the same weight and outside diameter; but, owing to its much greater thickness, the aluminum tube can be made of larger diameter without danger of buckling, says Aluminum and Electrolysis. For bicycle handle bars aluminum has greater advantages, and if it could be readily plated it would be really valuable for this purpose. The difficulty of joining is much against it in most cases. For the comparison of strength and rigidity the tubes tested were both 1 in. outside diameter, and practically of the same weight per foot: the steel tube was 20 gage, or 0·036 in. thick, and the aluminum alloy 12 gage, or 0·110 in. thick. The superiority of the steel tube was due to its greater mean diameter. Making allowance for this, the strength and stiffness of the two materials are nearly equal. The maximum stress in the steel tube was 52 tons per square inch, and in the aluminum alloy, 18·7 tons per square inch. The effect of a brazen heat was to reduce the strength of the steel by 45 per cent., thus bringing down its maximum stress to 28·6 tons per square inch; the stiffness was unaffected.

Talc is extracted on a large scale from the granite mountain of St. Barthelemy, in the French Department of Arriège, about 32 kilometers (20 miles) from the main chain of the Pyrenees. The principal quarry at Trimoum is worked open cast in three banks or terraces, each about 15 meters (49 feet) high. The best rock is of a bright white tint, and feels greasy to the touch when reduced to fine powder. The quarried rock is brought by a tramway to the end of the quarry in the Axiat Valley, and then by wagons for a distance of 19 kilometers (11 miles) to Luzenac, where 90 H. water power is taken from the Arriège River. The mechanical preparation consists of drying in a rotary oven, breaking up small, grinding and sifting, the grinding being effected in mills with steel balls. The larger portion of the product, observes an Ingénieur des Arts et Manufactures, who has communicated these particulars to the Chronique Industrielle, is converted into powder, only a small portion being sent away in the rough state, or cut into pencils for writing on metals. Besides its use throughout most parts of Europe and America, in soap and paper making, talc enters into the composition of wagon axle grease, while it also serves as an insulator for electric conductors.

Consul Morris, of Ghent, under date of September 3, 1897, says: The common council of Courtrai, Belgium, has just voted the exemption from certain taxes for workingmen who build dwellings for their own use. The conditions in brief are: There shall be exempted from the building, paving and sewerage tax: (1) the workingman who, not being an owner of real estate, erects or transforms a building destined to be used by him as a dwelling, and who has secured the property in accordance with certain conditions accorded to workingmen; (2) all societies associated with the Savings Bureau of the Government which erect or transform buildings by one of the methods prescribed by the said bureau, thereby assisting workmen to the ownership of a dwelling house; (3) incorporated associations, organized for a period of at least ten years, which erect buildings destined to be rented to workingmen and which agree in their charter that their dividends shall not exceed 3 per cent. The taxes are payable: (1) if the workingman does not actually occupy this house within three months after it becomes inhabitable; (2) if, before the expiration of five years, he ceases to occupy it or transfers the property to another party not entitled to the exemption; (3) if he establishes in it the sale of liquors. The corporations mentioned must be chartered and must publish their by-laws. If they do not fulfill all details of law, they forfeit their rights to exemption. At Bruges, in 1890, the common council voted the abolition of these same taxes in favor of all properties the annual income of which was less than $27.80.

AUTOMATIC WEAPONS.

THE advantages and disadvantages of the repeating gun have been discussed by specialists for nearly twenty years. Although most armies have hesitated to introduce it, it is not for want of very practical systems, with magazine or loader, permitting of obtaining great rapidity in firing, but rather on account of this very rapidity, which many military men fear as the surest means of depriving them of ammunition before the end of an unimportant battle. According to most officers, the discipline of firing would, only with difficulty, reach such a degree of perfection that it would be possible, at will, to quicken or retard the speed of firing of a troop provided with repeating guns. To-day, either because confidence in the education of troops has increased, or because the great European nations have acted in the matter by simple spirit of imitation, the cause of the rapid fire gun has won.

From the repeating system (rapid in charging, but slow in discharging) one has passed almost everywhere to the gun with a loader into which all the cartridges, generally twelve in number, may be introduced in a few seconds.

There remains only one more step to be taken in order to obtain the possible maximum of firing speed, through the use of the automatic weapon. This latter will perhaps be assailed by means of the arguments that retarded the use of the repeating gun, but there is no doubt that it will triumph over them, for the same reasons. The whole question at present is to know what system will prevail.

Up to the present, two processes have been employed for the maneuver of automatic mitrailleuses. In one (the Maxim) the recoil of the barrel is used for actuating the mechanism, while in the other (recently adopted by the Hotchkiss establishment) it is an escape of gas that serves to effect the motion. This process is older in the portable gun, the one that we are about to describe, and the construction of which is due to the Brothers Clair, of Saint Etienne. Not much studied up to the present as a war gun, this weapon has, nevertheless, reached a high degree of perfection as a sporting piece. It will not call forth the objections urged not long ago against the rapid fire gun used in the army. In hunting, the inconvenience of finding one's self deprived of ammunition is minimum, and one will scarcely reach the end of his supply of cartridges unless he engages in a genuine massacre. At the most, a sportsman who alone is provided with the new gun will be looked upon with an evil eye by his companions, to whose detriment he will destroy the game.

Fig. 1 gives an idea of the mechanism of the Clair gun. Not far from the edge of the muzzle there is a lateral aperture that gives access to a cylindrical chamber closed by a piston. The latter is mounted upon a hollow rod fixed at the rear to a rod connected with the maneuvering handle of the breech mechanism. Upon the whole, this mechanism is quite similar to that of the Mannlicher gun, with simple motion from front to rear, without a revolving motion for cocking. The mechanism may be actuated by hand either for loading the weapon for the first time, or even during the course of firing; but, normally, it is the escape of gas in front that, acting upon the piston, furnishes the energy necessary for the maneuver.

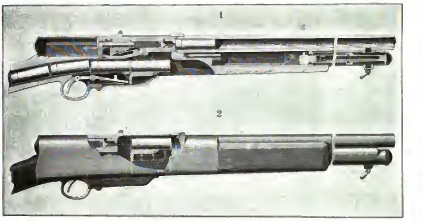


FIG. 1.—THE CLAIR AUTOMATICALLY LOADING GUN.

The piston, after its work is finished, is shoved forward by a spring; the breech closes, and the gun is ready for firing. This motion is extremely rapid. It requires close attention to follow it with the eye, and, in all cases, the gun is ready for firing before the sportsman has had time to raise the trigger and press it anew.

Fig. 3 is an exact reproduction of an instantaneous photograph taken during a firing with the Clair gun. Above the sportsman will be seen the empty shells, which have not had time to fall to the ground in the interval between shots.

If it happens that the sportsman does not wish to make use of the automatic reloading device, it will suffice to remove a screw plug, so as to allow the gas to escape to the exterior and no longer actuate the mechanism. It is almost useless to remark that the piston rod can act upon the breech mechanism only through a thrust, and that it is not carried along in the motion by the hand.

In the sporting gun, the cartridges are introduced one by one into the butt end through the loading aperture situated beneath the breech. The army gun, on the contrary, is provided with a loader.

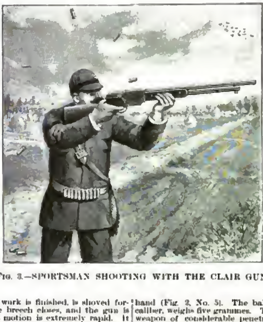


FIG. 3.—SPORTSMAN SHOOTING WITH THE CLAIR GUN.

The second weapon that we shall describe is a repeating pistol invented by M. Borchardt, and that appears to have been submitted to a series of experiments by the German military authorities. This pistol (Fig. 2) is of the type known in France as the mitrailleuse. Like the Maxim gun, the Borchardt pistol operates through the recoil of the barrel, which slides in two grooves that serve as a guide, and shoves backward, by an abrupt motion, a jointed rod of which the pivoting point is situated in the posterior appendage of the weapon.

For the position of the handle, a return has been made to an old form once used in certain fancy weapons. The body of the pistol rests upon this through its center of gravity, thus giving the hand a minimum of effort in firing with extended arm. Such position of the handle, moreover, was indicated by its function. It serves, in fact, as a sheath for the loader, which contains eight cartridges, and which may be replaced instantaneously, when exhausted, by another and full one. This arrangement, furthermore, permits of utilizing the entire length of the weapon for the line of aiming—a very important condition for accuracy in firing. As with the gun above described, the automatic loading may be replaced by a maneuver by hand (Fig. 2, No. 5). The ball, which is of 7·7 mm. caliber, weighs five grammes. This pistol is a very fine weapon of considerable penetration and great accuracy, and is very usefully completed, especially for war purposes, by arrangements that assure ease of carriage and increase the accuracy of its firing. For a march, it is strapped to a piece of wood in the form of the butt end of a gun, and is inclosed in a leather case to protect it against rain and dust. When it is to be employed, it is unstrapped and used as an ordinary revolver, or affixed to the butt end and used for shoulder firing.

We complete our description in saying that the weapon, suspended on the right side by a shoulder strap, for marching, can be affixed to the butt end in the vicinity of the enemy, so as to be made instantaneously ready for firing.

This new pistol is not only interesting by its ingenious mechanism, its exceptional ballistic qualities, its rapid fire and ease of carriage, for it may be said without any exaggeration that it prepares the way for an evolution in the armament of mounted troops, of artillery of all categories, of military bicyclists, and, in a general way, of all bodies of soldiery whose firing is done only at short or medium distances, and by whom portable firearms are used only exceptionally and to whom they should never prove cumbersome.—La Nature.

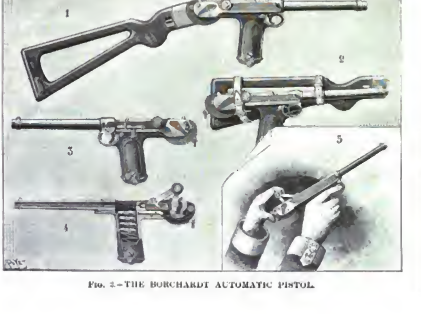


FIG. 2.—THE BORCHARDT AUTOMATIC PISTOL.

The results of some paint tests were exhibited at the October meeting of the Civil Engineers' Society of St. Paul, says the Railway Master Mechanic. Twenty-odd samples were shown of black and more or less rust roughened plates of sheet iron which had undergone six months' exposure to locomotive smoke while suspended from the roof of the Union Depot train shed about 50 feet above the tracks. The iron plates, originally new and bright, had each received one coat of paint and had been subjected to equal exposure. The red lead samples gave the best results, next came the white lead, followed by the iron oxides and the asphaltum, which were generally in much better condition than the graphites. An anti-rust specimen was the brownest specimen of the lot.

ELECTRIC TOWAGE ON CANALS.

THE towboats that we have described in a previous article are especially adapted for hauling barges over natural channels. To secure the most economical results, the traction ought to be supplied to the convoys as continuously as possible. This favorable condition is found on rivers either in their natural state or regulated, and usually only interrupted by locks of large dimensions and at long distances apart. But the conditions are very different for the most part on canals, where locks are generally numerous, and not large enough to receive a convoy; the length of the reaches is also, as a rule, very unequal, and under these conditions the haulage of long tows becomes impracticable. Where it is necessary to lock the boats one by one, it is evident that the difficulties of economical haulage in groups become excessive, and for this reason the use of horses has been hitherto found most advantageous, in spite of the numerous experiments in mechanical traction that have been made. The chief obstacle has arisen from the necessity of dividing among a large number of barges the small and independent units of power necessary for each.

The first cost of any such installation must unavoidably be large; and in order to compete with the cheaper horse traction, the expenses of working must be very low. For this reason those systems of mechanical haulage that require the employment of an additional man on each boat involve additional cost, and thus render them inapplicable. Towing by light locomotives running on rails laid upon the canal bank possesses many well-defined advantages, but is attended with other difficulties besides that of excessive cost. It is not a part of the scheme of these articles to consider the relative advantages and drawbacks of the various methods of mechanical haulage on canals; and we refer to them simply as an introduction to a method which has recently been tested on the St. Denis Canal, and which is a modification of the Bovet system, that we have described.

About forty years ago a M. Bouquier suggested a solution to the problem of mechanical traction for canal boats. He proposed to place on board each barge an apparatus consisting of a portable engine driving a paddle wheel by a belt; this wheel was mounted so as to project from one side of the boat. Arrangement was made by which the whole device could be easily shifted from one boat to another, so that a maximum of work could be obtained with one plant. Numerous trials of this system were made, but it was ultimately unsuccessful, on account of the difficulty of transshipping the motor, and the cost of working. M. Bovet has, however, under widely different conditions, followed the lines of Bouquier, substituting an electrical for a mechanical motor. By this arrangement he has reduced the weight of the apparatus to about a ton, which does not appreciably reduce the carrying capacity of the boat. In the arrangement adopted no projection from the boat affects its width, so that the barges can be built as wide as the dimensions of the locks permit; this is an important detail, as it affects the prices charged for carrying freight.

The management of the electric motor is so simple that it can be intrusted to one of the boat's crew, so that no additional charge for wages is incurred. It is evident that electricity is better adapted than any other force for subdivision to actuate small powers, and a part of the current can be utilized for magnetizing the two pulleys. Figs. 1 to 5 indicate the way in which the plan has been experimentally tried on the St. Denis Canal. The barge employed carries about 300 tons, and is of the standard type used on the canals in the north of France. It is an unsightly structure, and offers a maximum resistance to towage. On the other hand, it is cheap to construct and contains the greatest room for stowage; the type is, in fact, one that has been evolved by experience. The towage gear and its motor are inclosed in a sheet iron box, and placed on the forward part of the boat, on a tripod frame, each leg being held by screws to the floor of the barge. The box is free to slide inboard on the frame in passing through locks. The current is brought to the motor from a cable carried on posts along the canal bank, there being a trolley running on the cable. From the trolley passes a flexible cable that extends to a mast on the barge; this cable is led over a pulley, and down the mast, and thence to the towing gear. At the bottom of the mast the cable is wound over a compensating drum, which always preserves a sufficient margin of cable to compensate for deviations in the course; the drum is controlled by a spring that winds up any slack that may have been drawn off.

This means of regulation is necessary, as the mast has usually to be removed in going under bridges, and the cable has to be raised when passing other boats. It has been proved that this arrangement is much more satisfactory than a permanent trolley; not only because it must be placed high enough to clear obstacles met, such as masts, funnels, etc., but also because the trolley cannot be kept to a line over the boat, nor even on one side, as on many of the Brussels tramways, on account of the irregularities in width of water, formation

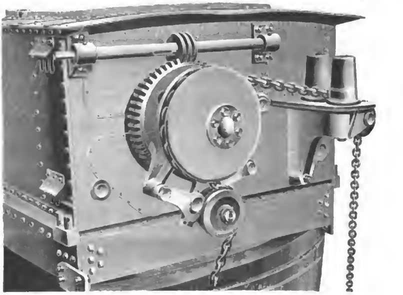


FIG. 6.

FIG. 2.

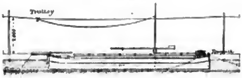
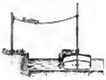


FIG. 3.



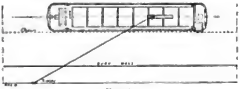


FIG. 4.

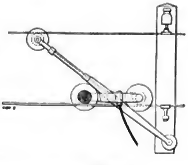


FIG. 5.

FIG. 1.

ELECTRIC TOWAGE ON CANALS.

of banks, etc. It has not been found practicable to make use of the submerged chain for the return circuit; the resistance is too great. This was clearly proved by the earlier experiments, and it was found necessary that there should be a return cable, and consequently that two trolleys must be used. Those that were first used, and answered well, were made with two deep grooved wheels on a counterweight; one of these trolleys was drawn by the cable and hauled the other. Of course there are various ways of making such trolleys, dependent on the special conditions. One satisfactory form is shown in Fig. 5. It consists of one trolley running on the lower line, and carrying a smaller trolley bearing on the upper cable, either by means of a lever and counterweight or by a spring. This trolley is not liable to derailment, and the man in charge of the boat has only one trolley, instead of two, to look after. The upper trolley can be easily shifted and the boat stopped, or if the way has to be cleared, the whole device can be brought inboard by means of a boat hook.

The tow gear that has been used consists of an electromotor running at 1,000 revolutions, and driving an intermediate shaft by contact between a cast iron fly wheel and a magnetized friction roller; from this countershaft the transmission to the tow pulley is by gearing. The diameter of the tow pulley at the bottom of the groove is 0·40 meter, and the normal speed at which it is driven is 40 revolutions, corresponding to 3 kilometers an hour. As in the Rue Royale sewer installation, already described, the chain rising from the water is guided by a heavy roller, the chain being assisted to leave the magnetized pulley by means of an insulated, or non-magnetic, metal lever. This lever and the guide roller are mounted on an eccentric wheel controlled by an endless screw to regulate the angle of winding round the tow pulley; this can be as much as 270°, or reduced to nothing when it is desired to throw off the chain. Figs. 4 and 6 illustrate the installation very clearly; the latter is an enlarged view of the towing device and the former a general view of the barge fully equipped. It should be mentioned that the wooden shelter shown on the barge was erected to protect the measuring instruments used during the experiments, and does not form any part of the installation. The barge with a load of 300 tons was hauled at a speed of from 2·8 to 3·8 kilometers per hour, with a current of 20 amperes and 110 volts at the station. At starting the current rose to 60 amperes, and then fell gradually, the normal rate being reached when the boat had traversed 80 meters. No difficulty was experienced with steering, in spite of the fact that the tow gear was on one side of the boat, and the trolleys gave no trouble. The conducting cables were needlessly heavy, being adapted for a current of 110 volts; they would have been, of course, much lighter for a 500 volt current. The experimental apparatus we have described and illustrated would be considerably modified for regular service.

The several applications of the Bovet system which are described prove the possibility of utilizing magnetic attraction for the development of considerable efforts; and it may be readily seen that the useful variations of this method may be numerous. In the course of the investigations he has made while pursuing the question of electric towage, M. de Bovet has been led aside in certain important deviations, especially with regard to transmission of power, and magnetic brakes; these have been very fully described in the Transactions of the Société Internationale des Electriciens, of Paris.—Engineering.

RADIUS OF ACTION OF ELECTRIC MOTOR CARRIAGES.*

THE objection that is most frequently raised against the electric motor carriage is "the difficulty of getting it charged." It has come to be the general conclusion among people even well versed in motor vehicle matters that a carriage propelled by electric storage batteries is unable to run beyond a very limited distance from an electric light station. In numerous instances even some of the technical journals devoted to the motor vehicle industry have carefully excluded the electric storage battery from the list of possibly successful motive systems.

So persistent have been these contentions that even in the minds of those who have had actual experience with well equipped electric motor carriages this question became one of doubt. In no recorded case had any one made an actual trial in a properly constructed electric carriage with a view to definitely ascertaining just where the touring limits of the electric carriage actually lay. It has been the good fortune of the writer recently to make an actual test of this question in one of the Pope Manufacturing Company's Columbia carriages. Although the makers expressly declare the vehicles to be designed for city and suburban service, and do not regard them as adapted to touring purposes, these carriages are fitted with the latest achievements in electrical traction apparatus, and the opportunity for the procuring of valuable information was an exceptional one. The experience, according to the best knowledge of the writer, is the first that has been recorded in which a carriage propelled by an electric storage battery was used for the purpose described.

The start was made from Hartford, Conn., one evening, with the intention of running through to Springfield, Mass., returning the next morning. Stops were to be made at as many towns along the route as was possible, in order to ascertain by experience what might be the actual difficulties, if any, of getting current for charging the storage batteries.

As the Columbia carriages are geared to a fixed speed of twelve miles per hour on a level, no consideration could, of course, be given to the question of speed, although the times of running were noted.

The first town out of Hartford was Windsor. The distance from the starting point was eight miles and the time occupied in making the distance was thirty-five minutes. The roads were in good condition, but quite hilly. The battery indicating meter indicated that $1\frac{1}{8}$ kilowatt hours of the total of 5 in the batteries had been used.

Upon arriving at Windsor information was asked as to the possibilities of getting electric current for charging the storage batteries. The information received was that the only place available was the works of the Eddy Electric Company, which were closed during the night. We were informed, however, that during the day time current was available at this place.

The journey northward was then continued, the next town being Windsor Locks. The distance from the starting point in Hartford to this place was thirteen miles, and the time occupied in getting there was one hour and fifteen minutes. Part of the road was through very deep and soft sand and numerous bad hills had to be ascended. Upon arriving in Windsor Locks inquiry was again quietly made as to the possibility of obtaining current for charging the storage batteries. We were promptly referred to the Windsor Locks electric light station. This place was found located at the foot of a short hill, the grade of which must have been 15 per cent.

Upon application at the station, it was found that the apparatus used for furnishing the town light was alternating, but that direct current was available from the exciting machines used in exciting the fields of the alternating current generators. The officials in charge of the station were most cordial, and in a very short time the necessary connections were made and the charging of the batteries in progress.

After permitting the charging to go on for about one-half hour, we considered the availability of current at this point adequately demonstrated. The wires were disconnected and we resumed the road northward after successfully navigating the 15 per cent. rise.

It had now become thoroughly dark, and the running through the quiet country in the cool, sweet scented air with the electric headlights of the carriage literally blazing was an experience inspiring to say the least. The almost noiseless action of the electric carriage and the perfection and simplicity of its control made the running seem ideal. Although the road throughout was entirely strange, it was found that the brilliancy of the electric headlights made traveling at night as safe as in the daylight. The road could be seen for at least 100 feet ahead, and the tinge of excitement when running into the dark, wooded districts added materially to the pleasure.

Thompsonville, on the east bank of the Connecticut River, which was crossed on the Enfield Bridge, was the next town reached. It is eight miles from Windsor Locks, and the time taken to make it was forty-two minutes. The roads were in very good condition and only one hill of any magnitude had to be ascended. Upon arriving, information was again asked as to the possibilities of obtaining electricity for charging the storage batteries, and we were at once directed to the Enfield Electric Light and Power Company. The carriage was run to this place, where it was found that Edison direct current apparatus was in use, which could be connected directly to the carriage terminals without any change whatsoever.

Although the people at this station had never before seen a motor carriage, the necessary connections were quickly made and in fifteen minutes the charging was in progress.

After remaining a short time the terminals were again disconnected and, after giving the officials at this station a sample ride about the town, the road for Springfield was again resumed. This road was found to be in excellent condition, but to have very many severe hills. All of the ascents of these hills, however, were made at a smart pace, thanks to the continued freshening the batteries had received, and it is needless to say that, owing to the now late hour, the descents were made at something more than a smart pace. In some places there is no doubt that the speed was fully 35 miles per hour. The road from Thompsonville to Springfield is through a fairly well settled country and is extremely pleasant riding. Springfield is about eight miles distant, and the time occupied in making it was forty-seven minutes. Arriving at Springfield, which has a large and unusually well equipped and regulated electric light station, we proceeded at once to the latter place. It was found here that alternating apparatus was the principal one used, and that, as at Windsor Locks, it was necessary to get the current from the exciting machines. Through the courtesy of the management, this was soon arranged, however, and the carriage was shortly being charged. At this place the battery indicator indicated three spaces of the five on the battery indicator as used. As it was desired to run about the city of Springfield in the morning before returning to Hartford, the batteries were charged until the indicating finger had returned completely to the "full" position. Having returned to this point, we departed for the Massasoit Hotel. Arriving here, we went through the ordinary procedure at the stable precisely as though we had an ordinary horse and carriage. Instructions were left with the stable keeper to wash the carriage in the morning, precisely as he would any other carriage.

In the morning, after breakfasting and listening to the interested talk of numerous people who had seen the carriage on the previous evening, we repaired to the stable and found everything in perfect condition. We then visited numerous places in the city, giving different people short rides, and at 9:30 we started on the return to Thompsonville.

Thanks to our generous dispensation of rides in Springfield, when about two miles out of Thompsonville the battery indicator showed that almost the entire contents of the battery had been consumed. On the arrival of the carriage at the electric light station in Thompsonville it was noted that the carriage was rapidly slowing down, although it was very plain that the batteries were still "willing." This characteristic of the electric storage battery to respond even to the most abusive loads is one of its most useful peculiarities, which, when understood, gives it a warm place in the heart of the motor carriage driver, and insures the electric carriage a permanent place in those fields where its limited radius of action is of small importance. Not until the last bit of current has been removed will it yield, and even then, after a short rest, it makes an effort to do one's bidding. A good storage battery is like a good dog.

The batteries were completely filled at Thompsonville. The return trip over the road to Windsor Locks was a very rapid and most enjoyable one, and owing to the daylight and the publicity of the occasion, considerable excitement was caused along the road. Although carriages equipped with other kinds of power have passed along this road in the past, the fact that this was the first "motor voiture de luxe" prevented any diminution in the interest shown. Windsor Locks was passed at a good twelve-mile gait and Windsor reached without a stop from the time we left the electric light station at Thompsonville. The distance between the two places is between twelve and fourteen miles and the time occupied in making it was one hour and five minutes.

A short stop was made at the Eddy Electric Company, through the courtesy of whom we were able to carry out our intention to ascertain officially the availability of current on subsequent trips through Windsor and to make a specimen charge, after which the return trip was resumed. The works of the Eddy company are eight miles from the place where the carriage is kept at Hartford, and the time occupied in making the run was forty minutes. The arrival home completed what is probably the first country trip of any electric carriage, the use of which, it is now apparent, is in some localities in fields beyond those to which its essential peculiarities ordinarily confine it. The makers of the Columbia carriages issue with their vehicles an interesting little pamphlet giving such information as is necessary to extend this field to the utmost, including a list of the principal charging stations in some of the Middle and Eastern States.

It was found on the trip that the cost of electric current at the different electric light stations was such as to make the cost of running between $1\frac{1}{2}$ and 2 cents per mile. In the smaller country stations the charges are high, but in the large cities the charges are such as to make the cost of running comparable with those of gasoline carriages. Six cents per kilowatt hour is the average price charged at large stations, resulting in a cost per mile of $1\frac{1}{4}$ cents.

To ascertain the ability to make an extended tour in the Eastern States, an examination into the location of the different electric light stations was made by the writer. The results of this investigation indicated that, starting from, for instance, Hartford, current could be obtained at intervals which would enable an electric carriage to easily run to Boston. Current is obtainable at Thompsonville, Conn.; Springfield, Mass., which is twenty-nine miles from Hartford; Palmer, which is sixteen miles from Springfield; Warren, which is eleven miles from Palmer; South Spencer, which is eleven miles from Warren; Worcester, which is seventeen miles from South Spencer; Westboro, which is thirteen miles from Worcester; South Framingham, which is ten miles from Westboro; Wellesley, which is seven miles from South Framingham; Newton, which is eight miles from Wellesley; and Boston, which is seven miles from Newton. Of course, there would be no need of stopping at all these stations, as the batteries in the Columbia carriage are good for twenty-five miles on ordinary country roads.

In the first part of the eastward trip from Springfield the roads are very hilly and sandy, and it is probable that the mileage of the batteries here would not be greater than twenty; but, even so, it is seen that electric light facilities are ample.

Going westward from Hartford, it was found that electric light stations where current is available are located at New Britain, ten miles from Hartford; Meriden, ten miles from New Britain; New Haven, nineteen miles from Meriden, but between which there are large mills using electric lights and willing to sell it to carriage users; Naugatuck, which is thirteen miles from New Haven; Bridgeport, which is five miles from Naugatuck; South Norwalk, which is fourteen miles from Bridgeport; Stamford, which is eight miles from South Norwalk; Port Chester which is eight miles from Stamford; Mamaroneck, which is five miles from Port Chester; Mount Vernon, which is seven miles from Mamaroneck; and Forty-second Street, New York City, which is fourteen miles from Mount Vernon. In New York current is available in almost any locality, even at many private residences.

In running out of New York it is found that the electric light stations up the Hudson River toward Albany are at near enough intervals to make touring also possible, and the same is the case between New York and Philadelphia. In the vicinity of Philadelphia the facilities are not quite so good in all directions, although the most enjoyable trips are in the direction in which electric current is available.

The only disadvantage that can be connected with the charging of storage batteries is the time required. In recharging mechanical carriages it is, of course, merely necessary to obtain the fuel. In the case of an electric carriage, however, a certain amount of time is necessary. In no case, however, unless the batteries are completely discharged or empty, is it necessary to take more than one and one-half hours. In many instances in the experience of the writer, the current consumed in a run of twenty miles has been returned in one and one-half hours.

Of course, at the present time the best recharging facilities exist in the Eastern States. It is probable, however, that even in the Middle-Western States the distances between stations where current can be purchased is so small that touring is possible whenever the condition of the roads would permit.

In this connection, and in conclusion, it may be interesting to state the number of towns and cities in the different Eastern and Middle States that have regularly equipped electric light stations. The following is a list:

Maine	30	New Hampshire	35
Vermont	23	Massachusetts	99
Rhode Island	12	Connecticut	34
New York	183	New Jersey	61
Pennsylvania	190	Delaware	5
Maryland	21	District of Columbia	2
Virginia	37	West Virginia	21
Ohio	138	Michigan	117
Indiana	96	Illinois	197
Kentucky	37	Iowa	106

* By Hiram Percy Maxim, in the Horseless Age.

A report of the United States Geological Survey states that coal getting machines are now being used to a greater or lesser extent in fifteen of the States. In 1896 the coal mined in these States by machinery amounted to 12,358,522 tons, or 13 per cent. of the aggregate output of those States for the year. The use of machines is likely to increase where they can be adopted with advantage.

BEESWAX ASSAY.

WAX analysis is not difficult, though unfortunately somewhat tedious, since no single test is available by which you are able to say that it is pure beeswax.

Beeswax is an important pharmaceutical substance, and also is extensively used in the arts.

Beeswax has, like that closely allied class of substances, the fixed oils, been the successful subject of the adulterator. Formerly it was largely adulterated with simple substances, such as flour, earthy matter, ferric oxide, etc. These still can often be found in wax, but are due as a rule to imperfect collection, and not as adulterations and makeweights. For the purpose of adulterating wax these obviously apparent admixtures have been supplanted to a large extent by use of other waxes so closely allied to the true beeswax that it now requires a careful and accurate analysis to detect them, identification often being impossible.

The Melting Point.—Different methods for the determination of this most important factor have from time to time been described, often one only being a modification of another.

The pharmacopœial method is naturally one which comes before us most prominently; the details given in the B. P. are familiar to all, and therefore need no explanation. The B. P., however, does not describe it quite accurately enough, for no mention is made of the fact that the melting point should not be determined until some hours have elapsed after the wax has been drawn into the capillary tube. This is a most important detail, for recently melted wax will remelt at a much lower temperature, and consequently you will obtain a lower result than is really the case.

The best way to determine this point by the capillary tube process is to work upon the lines indicated by the Hungarian Society of Analysts. They direct that the wax should be drawn up into a long capillary glass tube; seal the lower end, and attach it to the bulb of the thermometer in the usual way, so that the column of wax corresponds to the bulb of mercury. After twenty-four hours, place the thermometer into a glass test tube filled with glycerin and heat very gradually.

By observing details like these in such a test, the results are sure to be more reliable and comparable.

Pohl's process is a simple one, and yields very concordant results. The bulb of the thermometer is dipped into melted wax, so as to obtain a film of wax, then the instrument is fixed in a long clear glass test tube. After allowing the wax to become properly "set," which generally requires at least six hours, heat gradually by holding the tube containing the thermometer over a thick iron plate heated in the usual manner. The moment the wax forms a drop on the end of the bulb of the thermometer, note the temperature, which is the melting point.

Redwood proposes a modification of this method. Instead of placing the wax on the thermometer he lets melted wax (a small quantity) fall upon some mercury contained in a dish to which is attached a thermometer. Apply heat gradually, and the moment the wax disperses as a film observe the temperature, which is the melting point.

Specific Gravity.—For the determination of this essential point there are many various processes employed, but the majority of them depend on the use of special apparatus, generally of a most costly description, so there is no need to refer to them. On the other hand, there are several useful and accurate methods which can be employed without the expense of such appliances.

Hager's Process.—The essential feature of this method is to find the specific gravity of the liquid in which the wax will remain suspended in equilibrium.

The method of working this process is a simple one. Melt the wax gently and allow it to fall from a moderate height into some alcohol, 70 per cent. With practice a large number of beads of wax are formed.

These, after allowing time for contraction to occur, are placed in some previously diluted alcohol. To this either a stronger or weaker alcohol is added, until the beads are suspended in equilibrium at 15·5° C.

It is essential that the beads should be fully contracted, for from Dieterich's experiments it is shown that a very considerable error may arise by using the wax too soon after it has melted.

In consequence of this possible error, Chattaway and Allen prefer to cut the wax into small cubes and brush them over with a wet brush before immersion, to prevent the adhesion of air bubbles.

The specific gravity of the wax is therefore the specific gravity of this liquid, which can be determined in the usual manner.

According to Proctor, 100 grains of wax, with a five grain weight stuck in it, should sink in water, but should float with a three grain weight.

Solubility.—The solubility of a wax should also be taken into consideration. It is soluble in ether at 22° C. Insoluble in cold but completely soluble in boiling alcohol. Chloroform dissolves out about 25 per cent. in the cold, but completely dissolves it when hot.

CHEMICAL TESTS.

Determination of the Free Acids.—Beeswax contains cerotic acid, which is soluble in boiling alcohol, and is capable of being neutralized by an alkali. Advantage of this fact is taken by analysts in determining the purity of wax, since about 12 to 16 per cent. of cerotic acid is invariably present. If the wax were always pure, it would be a simple matter to calculate the amount of this acid, but as it is so frequently adulterated with other substances containing a free acid, the result of this test is generally referred to as the number of milligrammes of KOH necessary to neutralize the free acids in one gramme of wax. This is called "the free acid value."

Saponification Value (Koettstorfer's Number).—The second of the great chemical tests for wax is the saponification value, which is the measure of the amount of alkali — KOH — required to completely saponify the whole of the wax. In the previous case only the acid soluble in hot alcohol was estimated, but in this case the insoluble portion—myricin—is also estimated. The ester myricin or myricin palmitate is not saponified by an aqueous solution of potash, the reaction only occurring in alcoholic solution.

The ester value indicates the number of milligrammes of $\frac{\text{KOH}}{N}$ required to saponify the neutral esters in one gramme of wax. In obtaining the acid value that portion of wax soluble in hot alcohol was estimated—cerotic acid. In obtaining the saponification value the insoluble as well as the soluble bodies were conjointly estimated—cerotic acid and myricin—provided, that is, the wax was pure.

It is evident, therefore, that the ester value is the difference between the acid value and the saponification value, or, in other words, the saponification value is the sum of the acid and ester values.

In practice the easiest way to obtain these figures is to first ascertain the acid value, and then add the alcoholic alkali and proceed as described under saponification value. Then the amount of alcoholic KOH used corresponds to the ester value, and the total alkali, both aqueous and alcoholic, is necessarily the saponification value.

IODINE AND BROMINE NUMBERS.

Whether pure beeswax does absorb any appreciable quantity of the halogen is a somewhat doubtful point. Most of the great workers on this subject do not refer to this test, while a few give a very low and variable figure, that may, I think, be disregarded. These tests are most valuable when regarded from a negative standpoint. Pure beeswax, we may take for granted, absorbs little iodine and bromine, while, on the other hand, several of its most frequent adulterants do absorb a large amount, more especially carnauba wax and tallow.

Resin is frequently referred to by the authorities on this subject as a favorite adulterant, but as far as my experience teaches me, it is not generally used at the present time, except in prepared waxes for technical purposes.

Like stearic acid, it is apt to alter the specific gravity, making it considerably higher. Resin specific gravity = 1·045, 1·108, Lewkowitsch. It also gives a higher acid value unless compensated. If suspected it can be isolated conveniently by boiling the wax in 50 per cent. alcohol; filtering when cold, and evaporating the filtrate to dryness, and weighing the product. By using weak alcohol, stearic acid is not extracted.

It is obvious, therefore, that, though these processes are of great utility in analyzing beeswax, the results are not altogether conclusive. Every sample should be boiled with alcohol; when cold, filtered and an equal volume of water added to one part and an equal volume of solution of chloride of calcium to another. In each case the solution should remain bright and clear, precipitates indicating the presence of Japan wax, resin, tallow, etc.

In addition to these two tests, the wax of doubtful character should be submitted to the halogen test; absorption of either iodine or bromine at once points to the presence of a foreign body, most probably carnauba wax, tallow, or resin.—Read at meeting of Chemists' Assistants' Association.

INTERNATIONAL METEOROLOGICAL CONFERENCES.*

By ROBERT H. SCOTT, M.A., F.R.S., Secretary to the International Meteorological Committee.

THERE is no science so dependent on international concord for its successful prosecution as meteorology; and, consequently, for nearly half a century past such meetings as that which has recently taken place in Paris have from time to time been held.

The first and most famous of these assemblies had reference exclusively to maritime meteorology. It was held in 1853, in Brussels, mainly at the instigation of the late Commander M. F. Maury. Out of that congress grew a system of meteorological observations at sea, to be carried out in a uniform manner by all the nations represented at the congress. The form in which the observations were to be recorded is known as the "Brussels Abstract Log."

Looking back, in 1896, to the ideas of 1853, and to the fulfillment which has been made good in the space of forty-three years, the first matter calling for notice is that the United States, which took the initiative in convening the first congress, have completely given up their co-operation in the work of recent years, and are devoting themselves entirely to the preparation and issue of pilot charts.

Only three nations have continued to work up, with more or less fidelity, to the standard sketched out at Brussels—Holland, Germany and this country; each of which has produced contributions, of more or less extent and value, to our knowledge of the meteorology of the ocean.

Our own meteorological department of the Board of Trade, under Admiral Fitz-Roy, took its rise out of the Brussels congress. It was founded in 1854. In a letter from the president and council of the Royal Society, dated February 22, 1855, which has repeatedly been reprinted, we find that it was then contemplated that the meteorology of the entire ocean might be ascertained with a considerable approach to accuracy, by the organization then called into being. The impossibility of carrying out these wishes was not then fully realized.

After the Brussels meeting, matters, as regards international meteorology, slept for nineteen years. In 1872 an invitation to a free unofficial meeting at Leipzig was issued by three eminent meteorologists—Dr. Carl Bruhns, Observatory, Leipzig; Dr. Carl Jelinek, Meteorological Institute, Vienna; and Dr. Henry Wild, director of the Central Physical Observatory, St. Petersburg.

This conference was attended by fifty-two persons, representing most of the states of Europe, and inter alia it passed a resolution recommending the establishment of special offices for maritime meteorology in all countries where the requirements of navigation called for such a measure.

Out of the conference of Leipzig, the congress of Vienna, 1873, arose. This was summoned through diplomatic channels. There were thirty-two delegates present. As regards maritime meteorology it simply confirmed the resolutions of Leipzig, and further recommended the convening of a conference in London, for the discussion of the subject of maritime meteorology. This conference was held from August 31 to September 2, 1874, and was attended by twenty-four persons. Its deliberations were mainly directed to the discussion of the Brussels Abstract Log, and of the methods for reduction and publication of the observations.

Four years elapsed, and in 1878 a report on maritime meteorology* was drawn up for presentation to the projected meteorological congress at Rome. This report was published by the meteorological council, and it contains, in the several answers to a circular of questions issued in 1877, a very complete résumé of the arrangements for the prosecution of ocean meteorology in the various countries of Europe and in the United States. The replies from Commodore Wyman, Hydrographer to the United States, from Capt. Eaups, representing the Ministère de la Marine, Paris, and from Sir F. J. Evans, K.C.B., Hydrographer to the Admiralty, were particularly detailed and instructive.

The congress of Rome, 1879, was fully official, like that of Vienna, six years previously. It was attended by forty persons. Its action, as regards maritime meteorology, consisted in expressing its satisfaction with the mutual understanding which had been the outcome of the London meeting, and its opinion that perfect liberty should be left to the nations interested in making mutual arrangements for the prosecution of their work.

Since 1879, no congress has been held. The absurdity of summoning duly accredited representatives of governments, who were charged to announce to their colleagues that the authorities at home refused to be bound by congress resolutions, was apparent. The subsequent meetings of Munich, 1891, and of Paris, 1896, have not been official—in other words, they have not been brought together through diplomatic channels, but have been collected by circulars addressed to the heads of the meteorological services in the different countries.

At Munich, in 1891, the only mention of maritime meteorology was a request that methods of discussion and of publication of results should be uniform all over the world. Compliance with this demand was recognized as impossible, owing to the admitted inequality of distribution of material in the different oceans.

We now come to the conference of Paris in September last. At this no person, except Lieut. Kosslitz, from Pola, represented an exclusively marine establishment. Mr. James Page came from the Hydrographic Office, Washington, but only in a private capacity, not as representing his office. The questions which had direct reference to the sea, and which were brought up for discussion at the meetings, were few in number.

The first was a proposal from Dr. Paul Schreiber, the director of the meteorological service of Saxony, for the development and multiplication of observations of sea surface temperature over the North Atlantic. Dr. Schreiber gave no suggestions as to carrying out his proposal, and so the conference contented itself with recognizing the desirability of its realization.

Dr. Biese, of Helsingfors, head of the meteorological service of Finland, requested the conference to pass a resolution supporting his efforts to create a department for hydrography and maritime meteorology in Finland. The conference decided that in the case of Dr. Biese's request, and other similar proposals, inasmuch as the meeting had no official status, it was not in its province to pass any resolution which might in any way suggest a course of action to any government. It therefore placed on record its sense of the importance of the objects which Dr. Biese and others sought to attain.

More than one gentleman sent requests to the conference to institute investigations into the origin and phenomena of cyclones, but it was fairly remarked that it would not be an easy task to moor a cyclone to one spot, so as to allow of time for instituting observations all round its center!

Dr. Paulsen, chief of the Danish meteorological service, produced a series of very interesting charts, showing the monthly distribution of floe ice in the North Atlantic. The information from Greenland and Iceland is collected from Danish vessels making passages to those colonies; for the sea northward toward Spitzbergen it is furnished by Norwegian whalers. Dr. Paulsen requested any gentlemen who had access to observations from the North Atlantic, north of the sixtieth parallel, to send these data to Copenhagen for the completion of his charts.

Mr. C. L. Wragge, of Brisbane, head of the meteorological service of Queensland, brought forward various propositions relative to the importance of securing observations from high southern latitudes. The desirability of procuring such information was recognized as incontestable, but no opinion was expressed as to its practicability.

Dr. Snellen, director of the Meteorological Institute of the Netherlands, proposed a resolution of a very general character, which was adopted by the conference, to the effect that it was desirable that a special conference be called together to discuss the subject of maritime meteorology. No definite programme of subjects for discussion at this conference, if it ever comes to pass, has yet been put forward.

In this connection we must notice a paper which was prepared for submission to the Paris conference by Dr. G. Neumayer, the Director of the Deutsche Seewarte in Hamburg. Dr. Neumayer is well entitled to speak with authority on the subject; for more than forty years ago he was working, at the Flagstaff Observatory, Melbourne, on the meteorology especially of the Southern Indian Ocean, on the track of the Australian trade. In the paper now under consideration he gives a masterly summary of the condition of the science at present all over the civilized world, and expresses his hopes that uniformity of methods, etc., may be introduced, but without making any practical suggestions as to how the object can be attained. The great point which Dr. Neumayer urges is the necessity for a more or less free interchange of material between the different offices.

The difficulty in carrying this out lies in the expense involved in such a communication of information. It is universally admitted that the original logs cannot be handed about from office to office. Copies must be made, and the cost of copying soon grows to be over-

* Nautical Magazine.

* Reports to the permanent committee of the first International congress of Vienna on atmospheric electricity, maritime meteorology and weather telegraphy. Published by authority of the Meteorological Council, London. Eyre & Spottiswoode, 1878.

whelming, for observations are required by tens and even hundreds of thousands.

The great difficulty of carrying out the idea conveyed in the letter from the Royal Society, already mentioned—that of publishing data for the entire sea surface—is at once evident when we consider that, in order to get observations, we must have ships, and ships will only be found along trade routes.

In the higher latitudes of both hemispheres the area from which materials are obtainable is strictly limited by the boundaries of ice prevalence.

In the South Atlantic Ocean observations are excessively rare from any parts except the belts marked by the tracks, outward and homeward, to and from the capes. In the Indian Ocean it is all but impossible to find observations for the vast region lying off the northwest coast of Australia.

As for the Pacific Ocean, no single part of it is covered with observations at all so thickly as even the less frequented parts of the other oceans.

We see, therefore, how much requires to be done before the meteorology of the sea can be held to have been thoroughly investigated.

As regards the proposal for a new conference, neither Dr. Neumayer nor Dr. Snellen has put forward a distinct programme, and without such a series of questions it is not easy to see how an invitation to a meeting has much chance of a favorable reception.

As regards the desirable uniformity of methods, the suggestions for work differ very widely. A few years ago an eminent Russian officer, Rear Admiral Makaroff, published the results of his observations in his ship, the Vitiaz, in the Pacific Ocean. In that volume he suggested far minuter work than has ever been attempted elsewhere. He asks that the actual day of the month on which an observation is taken should be stated, so as to show how the figures are affected by the season of the year!

In direct contrast to such nicety is the work turned out by the Hydrographic Office, Washington. This consists of pilot charts for each month, which fall out of date in a few weeks, and which Dr. Neumayer fairly describes as being ephemeral in character.

In conclusion, we regret that we are not able to say more than that the action of the Paris conference, as regards maritime meteorology, consisted in the registration of a certain number of good resolutions, without making any practical suggestions as to the methods for carrying them out.

THE CANOES OF THE MENOMINI INDIANS.

In the first part of the Fourteenth Annual Report of the Bureau of Ethnology to the Secretary of the Smithsonian Institution, 1892-1893, there is a very interesting and important monograph entitled "The Menomini Indians," by Walter James Hoffman, M.D. By the courtesy of the director of the Bureau of Ethnology we are enabled to present an engraving showing the setting up of a bark canoe, and our text is extracted from Dr. Hoffman's monograph.

The attention of some Menomini shamans who visited Washington was attracted by the work of the Bureau of Ethnology, and after protracted conferences the proposition was made by the chief, Niopet, that a visit to their reservation at Keshena, Wis., be made; that, after proper instruction by some shamans to be appointed, and due initiation into their society termed the Mitä´wit, their version of the traditions and dramatized forms of initiation should be studied, so that it could be preserved for the information of future generations of the Menomini. The first visit was made to Keshena in 1890, followed by four subsequent visits to attend to the necessary instructions and ceremonials of the society. It was during these visits that other new and interesting facts were obtained—material relating to their mythology, social organization and government customs, industries and linguistic germane to the subject in general. Space forbids even an outline of the interesting facts which are recorded in Dr. Hoffman's monograph.

The fabrication of Indian canoes is very interesting. The Menomini have almost entirely discontinued the making of the simple dugout and the birch bark canoe, and even among the old men but few are now recognized as having in their day been experts in this industrial art. The simpler form of boat was the dugout made of a single trunk, preferably that of a butternut

SIGNORA ZEFTHE AHAIRA.

tree. The wood is much heavier than most others available, but the Indians believe it resists better than any other variety the effects of long contact with water, as well as the erosion to which the bottom is subjected by frequent rowing in shallow streams in beds of gravel or bowlders.

The birch bark canoe is by far the most graceful piece of mechanism produced by the Menomini. The general form of the canoe differs to some extent among the various northern tribes. The type of canoe made by the Menomini resembles that of the Ojibwa, of Wisconsin, who are their nearest northern neighbors and with whom they have for many years maintained friendly relations, and to some extent intermarried. For their manufacture large birch trees that appear to furnish the best bark are selected and the pieces are cut as large as possible. These sections are sewed together with threads made of the long, thin roots of a species of spruce, a material durable and well adapted to a constant wetting.

The framework of the bark canoe is made of white cedar, which is durable, light and elastic. The ribs are thinned with a drawing knife, and when the required number have been made they are curved according to the parts of the canoe which they are intended to brace—the middle, of course, being much more distended laterally, while the ends gradually narrow to a point.

The tops of the ribs are held in place by being tied to a cross piece, the ribs and cross piece thus resembling a bow and its string. Then the entire series of ribs is fastened by tying to the longitudinal strips, corresponding to the gunwale, thus setting up the skeleton, as it were. These strips also are cut to the required thickness by means of a draw knife.

When the framework has reached this stage the bark, which in the meantime has been stitched together, is laid on the ground, the framework placed upon it, and then the bark is turned up over the sides; short posts are driven into the ground, all around the canoe, to hold the outside strips, to reinforce the edge or gunwale, and to prevent the breaking of the bark at the end. The appearance of the work at this stage is shown in our engraving. All the necessary stitching is then done to hold the tightly secured bark in place. The bow and the stern are still sufficiently unlike for the Indian to note which is the bow, for that end of the canoe, as in the dugout, is usually a little broader across the shoulders. The bottom of the canoe is lined with thin slats or shingles to protect the delicate bark from being broken. The seams, small punctures and knot holes are then sealed with pine resin.

Although the women have many duties to perform in connection with the building of a canoe—such as cord spinning, the stitching together of the pieces of bark and the final lashing of the long pieces forming the gunwale—the men usually do all the paddling when the canoes are in use.

The paddle is made of cedar or some other light wood. It measures about four feet in length, of which nearly one-half is devoted to the blade, which varies from four to six inches in width. Generally the top of the handle has two projecting pieces resembling a letter T, giving the oarsman an easy and effective means of holding and using the paddle. When not in use, the canoe is always pulled ashore and turned over, in order to allow the bottom to dry.

MENOMINI INDIANS SETTING UP A BARK CANOE.

SIGNORA ZEFTHE AHAIRA.

On October 18, Prof. Dr. Haberda, the Instructor of Medical Jurisprudence at the Vienna University, brought into his clinic one who appeared to be a small man with a heavy beard and mustache, and the students were greatly surprised to learn that this person was really a woman, although her strongly marked countenance, with its beard, her manner and bearing, and even her voice, were most masculine. Signora Zefthe Ahaira is thirty-three years old and was born in Tunis of Italian parents. She is the sixth in a family of fifteen children and the only one that developed any abnormality. She did not remain long in the convent in which she was to have been educated. At the age of fifteen she married and gave birth to a normal child, which, however, did not live long. As she and her husband were not happy together, they were soon divorced. Before her marriage, and while she lived with her husband, she kept her beard shaved, so that her appearance would not attract attention; but as the constant shaving became burdensome, she decided to let it grow and to adopt men's clothing, which she has worn uninterruptedly for a number of years, with the permission of the Italian authorities. She has conducted herself so like a man that no one suspected her of belonging to the "weaker sex," the impression thus conveyed being intensified by the manly tones of her voice. Prof. Haberda considers her a remarkable specimen of hermaphroditic formation. She is going to make a tour of Europe and America to give specialists a chance to study her.—Illustrirte Zeitung.

Cement pipes are made cheaply by an ingenious process devised by a French inventor. A trench is dug and the bottom filled with cement mortar. On this is placed a rubber tube covered with canvas and inflated; the trench is then filled up with cement. As soon as this is set the air is let out of the rubber tube, which is then removed and used again in another section. By this method six-inch pipes have been made at a cost of twenty-two cents a yard.

ACANTHOPANAX SESSILIFLORUM.*

ALTHOUGH, as the references show, this cannot be considered a new plant even in gardens, yet it is comparatively little known. We met with it in fruit lately in the nursery of M. Lemoine, at Nancy, and with the predatory instinct of the botanist, secured a specimen for the benefit of the readers of this journal. It is a handsome shrub, presumably perfectly hardy, with long stalked, palmately three-lobed leaves, the lobes leathery, dark green, broadly lanceolate, and tapering at each end, finely serrate at the margins. The flowers, which we did not see, are in globose heads, and are succeeded by black berries, each the size of a small pea, and reminding one of privet berries, or still more of ivy berries. The shrub is a native of the Amoor region, of the coast of Manchuria, and of North China. —The Gardeners' Chronicle.

A NATURALIST'S SOJOURN IN THE CRATER OF MAUNA LOA.

WHEN, at noon on August 8, I stood alone at the edge of the crater of Mokuaweoweo, my feelings were of a somewhat mixed character, says Dr. H. B. Guppy, of Hawaii, in the Pacific Commercial Advertiser. I had just said good-by to Mr. John Gaspar, who had brought me up, and before me lay a period of solitude of three weeks or more. From a previous ascent made on April 1, I gathered that it would be very cold, but beyond this I knew nothing of the climatic conditions to which I would be exposed. However, I set to work at once to arrange the interior of my tent, got out my meteorological instruments and planned my examination of the crater.

Before many days had passed it became apparent that the conditions of my existence were not unlike some of those to be found in the moon. In the complete sterility of the surface, in the very existence of the grim old crater, at the edge of which I had pitched my tent, in the rarefaction of the atmosphere, in the intense dryness of the air, as indicated by observations on the relative humidity; in the prevailing cloudless sky by day and in the clear starlit calm and dewless nights; in the severe cold at night and in the scorching of the sun in the day, there were produced many of the conditions we would look for in that planet. Then, again, the air at first was highly electrified. My red blanket crackled under my hands at night and I could trace on its surface in phosphorescent lines with my fingernail the letter A as I lay completely enveloped in its folds. The detached wings of dead butterflies picked up from the ground adhered provokingly to my fingers, and I began to imagine myself an electric battery. The effects of these meteorological conditions soon showed themselves in the cessation of the action of the skin, in severe headaches and sore throat; in a tendency to palpitation and dyspnea, and in sleeplessness, general lassitude and loss of appetite, most of which symptoms I attributed to the great lack of moisture in the air. I began seriously to think that Mr. Gaspar would find a mummy on his return, when a short spell of damp weather intervened, and, most of the unpleasant symptoms having disappeared, I began to take more interest in my surroundings.

And soon I found that I had a regular visitor twice a day in the shadow of the long mountain. For about twenty minutes after sunrise and before sunset the shadow of the mountain was thrown back against the sky of the opposite horizon. It seemed as if some Titanic brush had been at work on the sky far away, and had worked in the profile of the mountain with a very uncanny blue. Most evenings I used to light my pipe and watch the arrival and disappearance of the old mountain's shade. The peak was the last to go, and that was the signal for my retiring for the night. I was in the habit of getting up three or four times in the night to make observations of the wind and weather. At 1 A. M. on August 9 there was a most beautiful lunar halo, displaying most of the rainbow hues, the purple inside and the orange outside being most conspicuous. This was repeated in a less marked degree in the following night, and after that the phenomenon disappeared.

During my sojourn on the mountain top there was very little rain, only about 30-100 of an inch. Most of the rain on the summit fell during the night of August 12-13, and in that night I had an uncomfortable time of it. The wind was very gusty and was apparently disposed to lift up my tent and carry it bodily into the crater. It was bitterly cold, and I lay down with my boots on, lit my pipe and prepared for the worst. The canvas was reeking with the wet, and every fresh gust of the biting norther seemed to promise to deprive me of my shelter. Nature, however, came to my aid.

After sunset it began to freeze hard, and before long the canvas of my tent was as stiff as a board and no longer swayed to and fro with each gust of wind. I then fell asleep for an hour or two, and woke up to find the wind blowing strong from the south. A rapid thaw had set in, and the canvas was again soaking with wet, the water running down on my stores. This was repeated during the night, and to vary the entertainment there were two earth tremors, lasting in each case a few seconds. My tent, however, held bravely on. Sleep came to me in the early morning, and when I woke the sun was high up and there was a genial warmth in the tent.

The cloud effects were often magnificent. The snow-white sea of cumuli that gathered in the forenoon round the mountain slopes usually concealed the Kohala Mountains, but as a rule failed to hide the summit of Hualalai, and probably the level of its upper limit is on the average between 6,000 and 7,000 feet. Except on the few occasions when there were rain clouds about, the summits of Haleakala and Mauna Kea were always visible. On the forms and movements of the clouds I made regular observations. Perhaps the most striking phenomenon was that of the evanescent cirrus. In one minute the observer may be gazing at a cloudless sky overhead. In the next there appears as if by magic a large white cloud, which, being at no great elevation, is carried rapidly across the zenith and dissolves away in the course of a few minutes. The history of one of these clouds may thus be traced. The spectator looking, we will say, to the east, sees only the clear blue of a cloudless sky. Then suddenly a tiny white speck appears and in a few minutes the speck becomes a conspicuous cloud. In less than half a minute it has attained considerable dimensions, and as it is borne rapidly westward it exhibits violent commotion in its interior, frequently changing its form and in a few minutes melting away altogether. Sometimes, when there were a number of these cirri visible, the heavens presented quite a bewildering spectacle in quick appearance and disappearance of the clouds and in their frequent change of form.

There was a continual struggle between the northerly and southerly winds on the summit, the vicinity of my tent in the middle of the west side of the crater being their frequent battle ground. At such times miniature whirlwinds carried up sand and paper into the air, and if the tent was open, its interior became filled with dust. On the north and east sides the wind was usually northeast and easterly. On the south side it was south and easterly, while on the west side north to northwest and southwest to south-southwest were the prevailing directions of the wind, but the wind was rarely strong at the camp. One morning I left my tent at 7 o'clock with a light southerly breeze blowing, but after proceeding about half a mile to the north I found myself facing a bitterly cold northeast gale, against which I could scarcely stand, so that my purpose of going around the crater had to be abandoned for that day. Returning to the tent, I met the northerly wind once more.

My descent into the crater was made on the northwest side. It was a tedious operation, and one had to tread warily on the loose bowlders, that are often inclined to roll down and crush the intruder on his way. As soon as I reached near the center of the great pit the clouds began to pour in on all sides over the lips of the crater. In a few minutes I was enveloped in a dense mist, and any further observation was rendered impracticable. During the prevailing dry, clear weather with a cloudless sky, "smoke" is only evident in two places in the crater, one near the center and the other in the southwest corner from the base of a yellowish cliff, where there are apparently extensive deposits of sulphur. When, however, the sky is clouded, and especially when the air is moist, white vapor may be seen arising from the greater part of the surface of the crater. The change is a little startling, the true explanation being that a large amount of the vapor evolved is only visible in cloudy, murky weather. It is, therefore, possible that the accounts of two observers may vary greatly as to the crater's condition, and yet no difference in the condition actually exist. This especially applies to the district on the south and southwest borders of the crater, stretching about a mile to the southward. In cloudy weather white vapor arises from many places in this area. Many of these cracks and fissures exhibit evidence of having originally given passage to vapors at a very high temperature. The red glaze that coats their sides could never have been produced by the comparatively cool vapors now discharged from them. I should judge that the subterranean heat is now more actively displayed in the district extending a mile to the south of the big crater than in the crater itself. A very large amount of vapor is discharged from the borders of a small crater lying near Pohaku Hanalei, and this is probably the smoke sometimes observed from the Kona coast. One may expect that the next eruption will occur on this, the south-southwest slope of the mountain.

Curiously enough, insects of various descriptions are common on the summit. One species of butterfly common at the coast is not at all infrequent. The butterflies were more often to be found dead than alive, and those flying about were in a half drowsy condition and easily caught. There were flies of different kinds, the house fly and the bluebottle fly proving a great nuisance in my tent. Besides these there were moths, bees, gnats and an occasional dead dragon fly, while bugs and other insects were collected as they fed upon the bodies of the dead butterflies. These insects were more common when the wind was southerly, and no doubt they had been brought up to this absolutely sterile region by the wind. Evidently most, if not all, of the butterflies and moths soon die and probably the other insects, too. The whole matter is, however, very suggestive and shows how readily insects, even the parasitical bug, may find their way into the upper air currents.

During the last few days of my stay on the summit I found myself getting sensibly weaker, which I attributed partly to want of sleep and partly to lack of appetite. The kerosene had got mixed with the biscuit on the way up, and the sugar was in the same condition. Fancy also gave the same flavor to the bacon and rice, and I swallowed my food like so much sawdust. My face was like that of a coal heaver, washing being rather risky at that altitude. On the last day, however, I made myself a little respectable and awaited the arrival of the relieving party. When, therefore, on the evening of August 30 I heard the sound of voices, and the clatter of horses' feet outside the tent, I was not long in giving the party a welcome.

ACANTHOPANAX SESSILIFLORUM—BERRIES LUSTROUS BLACK.

* Acanthopanax sessiliflorum, Seemann in Journ. Botany, v (1867), 239; syn. Panax sessiliflorum, Ruprecht and Maximowicz, 1857, and Maximowicz, Primit. Flor. Amur. 131; Regel, Garten Flora (1862), t. 360, p. 339; Panax sessilifolium, C. Koch, Dendrol., i, 675.

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A NEW division in the middle ring of Saturn has been detected by Prof. Schaeberle. It is only partial, and is about the same width as Cassini's. Prof. Schaeberle thinks the division is not complete and that intervening matter reflects light so well that it is difficult to detect the division.

ON COMPUTING THE RADII OF AN ACHROMATIC OBJECTIVE.

By CHARLES L. WOODSIDE, Boston, Mass.

It is not the intention of the writer in this paper to discuss the comparative values and particular merits of the various forms of achromatic objectives, but to place before the reader a simple and effective means by which the radii of the four surfaces of such an objective may be easily and correctly obtained.

When, several years ago, the writer decided to grind an achromatic of five inches aperture, he found that the determination of the proper curves was no easy task, and although the lenses might have been ground on curves similar to some others, yet the element of uncertainty in the result was so great, owing largely to the fact that nothing was known of the refractive or dispersive powers of the glass which was intended to be used, that the writer decided to investigate the subject, first theoretically, then practically, in the hope of evolving some simple method of ascertaining the proper curves under such conditions; and, while no claim is made for originality of treatment, the writer hopes that the results of his experience may be worth recording for the benefit of those who are endeavoring to obtain objectives for themselves by their own handiwork.

The formula employed in computing the radii is practically that of Littrow, and an objective constructed according to this plan will have its crown lens double convex and its flint lens double concave generally, though sometimes concavo-convex. The first two surfaces, I and II, reckoning from the front of the objective, will always be of equal radii; III will be of nearly the same radius as II, and in certain cases the radii of I, II and III may be alike, while IIII will usually be of long radius, nearly flat.

In the making of an objective, if the indices of refraction and the ratio of the dispersions of the two pieces of glass are known, the four radii and resulting focal length may be computed with reasonable exactness before the work begins; but, if these quantities are not known, they must be assumed, and the resulting focal length will therefore be uncertain within small limits until the work has reached a certain stage of completion.

Presuming, then, that these quantities are known, we have:

μ = mean index of refraction } of the crown glass.
$D\mu$ = dispersion
μ' = mean index of refraction } of the flint glass.
$D\mu'$ = dispersion
λ = ratio of the dispersions.
δ = ratio of the dispersive powers (that is, the dispersions combined with the refractions) = ratio of the focal lengths of the lenses.
I = radius of the outer surface } of the crown lens.
II = radius of the contact surface
III = radius of the contact surface } of the flint lens.
IIII = radius of the outer surface
f_1 = focal length of the crown lens.
f_2 = focal length of the flint lens.
F = focal length of the objective.

Let us first compute λ, which we use as the argument of the "Table for Computing Radius III," thus:

$$\frac{D\mu}{D\mu'} = \lambda \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

and then compute δ, the ratio of the dispersive powers (and consequently the ratio of f_1 to f_2, inasmuch as the focal lengths of the lenses must be proportional to the dispersive powers), thus:

$$\lambda \div \frac{\mu - 1}{\mu' - 1} = \delta \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Having determined upon the focal length of the objective, we next compute f_1 thus:

$$F \times \frac{1 - \delta}{\delta} = f_1 \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

and f_2 thus:

$$f_1 \times \delta = f_2 \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

We now compute the radii of I and II thus:

$$f_2 \times 2 \times (\mu - 1) = I = II \ldots\ldots\ldots\ldots (5)$$

and then referring to the "Table for Computing Radius III" on next page, and using λ as the argument, we take out the quantities α, β and γ, and compute III thus:

$$f_2 \times \left[\alpha + \left(\beta \times (\mu - 1{\cdot}50)\right) + (\gamma \times (\mu' - 1{\cdot}60))\right] = III \ldots (6)$$

It only remains for us to compute IIII thus:

$$\frac{III \times \left(f_1 \times (\mu' - 1)\right)}{III - \left(f_1 \times (\mu' - 1)\right)} = IIII \ldots\ldots\ldots\ldots (7)$$

and we have the complete data for the construction of the objective.

Let us, for example, compute the radii of an objective of 60 in. focal length, using hard crown and dense flint glass, for which we find that:

μ = 1·52
μ' = 1·63
$D\mu$ = 0·014
$D\mu'$ = 0·028

$$\lambda = \frac{0{\cdot}014}{0{\cdot}028} = 0{\cdot}5 \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$\delta = 0{\cdot}5 \div \frac{0{\cdot}52}{0{\cdot}63} = 0{\cdot}60577 \ldots\ldots\ldots\ldots (2)$$

F = 60 in., and

$$f_1 = 60 \times \frac{1{\cdot} - 0{\cdot}60577}{0{\cdot}60577} = \frac{0{\cdot}39423}{0{\cdot}60577} = 39{\cdot}0474 \ldots\ldots (3)$$

$$f_2 = 39{\cdot}0474 \times 0{\cdot}60577 = 23{\cdot}6537 \ldots\ldots\ldots (4)$$

$$I \text{ (and II)} = 23{\cdot}6537 \times 2 \times 0{\cdot}52 = 24{\cdot}5998 \ldots\ldots\ldots (5)$$

From the Table, with $\lambda = 0{\cdot}5$ as the argument, we find that $\alpha = 1{\cdot}00273$, $\beta = 1{\cdot}331$ and $\gamma = 0{\cdot}623$; hence,

$$III = 1{\cdot}00273 + (1{\cdot}331 \times 0{\cdot}02 = 0{\cdot}02662) + (0{\cdot}623 \times 0{\cdot}03 = 0{\cdot}01869) = 1{\cdot}04804 \times 23{\cdot}6537 = 24{\cdot}7900 \ldots\ldots (6)$$

$$IIII = \frac{24{\cdot}79 \times (39{\cdot}0474 \times 0{\cdot}63)}{24{\cdot}79 - (39{\cdot}0474 \times 0{\cdot}63)} = \frac{609{\cdot}8305}{0{\cdot}1902} = 3206{\cdot}26 \ldots (7)$$

Therefore, we have—

I	24·60 in.
II	24·60 "
III	24·79 "
IIII	3206·26 "
F	60·00 "

It will at once be seen that the computation of the radii is extremely simple and direct, and requires no more knowledge of arithmetic than is commonly acquired in our public schools.

It has been stated above that in certain cases the radii of I, II and III may be made of equal length. The condition upon which this depends is that the computed radius of II (and I) must be slighter shorter than that of III. Such being the case, the radii of I and II may then be increased to equal that of III and the lenses separated a certain small distance exactly equal to the increase in focal length of the crown lens resulting from the increase in the radii of I and II. It may be remarked, however, that the distance by which the lenses are separated must not be large, and ought not in any case to exceed say one twenty-fifth of the focal length of the crown lens. It should also be noted that, although the actual focal length of the crown lens is increased, its equivalent or effective focal length remains unchanged, inasmuch as the separation reduces the power of the crown lens and thereby exactly compensates the increase of the focal length in its effect upon the chromatic and spherical aberrations; so that the value of f_1 becomes $f_1 - d$, and this expression is to be used in all cases where the lenses are separated, to represent the value of the focal length of the crown lens.

If an objective is to be constructed upon this plan, we compute the radii of the four surfaces in the usual way and then find the distance, d, by which the lenses are to be separated, thus:

$$I - \frac{II}{III} \times f_1 = d \ldots\ldots\ldots\ldots\ldots\ldots (8)$$

and then simply make the radii of I and II of the same length as III.

If we take, for instance, the previous example, we find that the radii of I and II = 24·60, while that of III = 24·79. The radii of the crown being shorter than III, the condition of separation is fulfilled and we compute the distance between the lenses, thus:

$$I - \frac{24{\cdot}60}{24{\cdot}79} = 0{\cdot}00772 \times 23{\cdot}6537 = 0{\cdot}1826$$

The radii of the objective will then be—

I, II, III	24·79	inches.
IIII	3206·26	"
d	0·1826	"
F	60·00	"

By this method of treatment, we have an objective at once effective, extremely simple in form and comparatively easy to produce, inasmuch as it requires but two pairs of tools, an item of no small consequence to the amateur. It may be urged, upon theoretical grounds, that the separating of the lenses is not conducive to the very best results; and while this is undoubtedly true when the separation is quite considerable, yet if the limit already named is not exceeded, the practical advantages of the form very much more than compensate any theoretical objection. In this connection it may be stated that the Clarks have separated the lenses of all their later large productions, including the 36 in. Lick objective.

Let us presume now that the objective is to be made from two pieces of glass, of the refractive and dispersive powers of which we know nothing. It is evident, from what has already been said, that the quantities μ, μ', λ and δ must be known before the radii of the objective can be computed. We must, therefore, proceed in a manner practically the reverse of that already employed, and first form the glass into lenses from which we may deduce these quantities with great accuracy, by the aid of which we may then compute the radii of the four surfaces in the usual way and complete the objective.

In the absence of any definite knowledge of the constitution of the glass, we must assume μ and δ, and upon the correctness of these assumptions will the focal length depend to some extent.

Perhaps the best and clearest way of showing this method of procedure is by a practical example from my own experience, in the making of a 5 in. objective. The two pieces of glass for this objective were obtained at different times, and beyond the fact that they were made by Feil, nothing was known concerning their optical properties. The ratio of their dispersive powers, δ, was assumed to be 0·63, from which it was found by equation 3 that for an objective of 62½ in. focal length, f_1 should be 36·70 in.

$$62{\cdot}5 \times \frac{1{\cdot}00 - 0{\cdot}63}{0{\cdot}63} = 36{\cdot}70$$

and by equation 4 that f_2 should be 23·12.

$$36{\cdot}70 \times 0{\cdot}63 = 23{\cdot}12$$

Next, the index of refraction of the crown glass, μ, was assumed to be 1·51, and the radii, I and II, necessary to give the required focal length, f_1, were found by equation 5 to be 23·58 in.

$$23{\cdot}12 \times 2 \times 0{\cdot}51 = 23{\cdot}58.$$

As these computations were approximations only, the radii of I and II were made 23·50, and one pair of tools was prepared of that curvature. Work was then begun on the crown lens, and it was ground and polished complete, great care being exercised in keeping the surfaces as true as possible to the curve. The front surface of the flint lens, III, was then ground with the convex mate of the tool used in grinding the crown lens, and for the back surface, IIII, a tool was used of 270 in. radius (which had strayed into my possession at some previous time) and these surfaces were then polished. Had not this tool been at hand, it would have been necessary to grind IIII of the same radius as III; but, had this been done, then only a little more than one-half the diameter of the lens (say 3 in. of a 5 in.) would have been ground, as, otherwise, the lens would be made too thin at the center, because of the great curvature of the tool.

After the lenses were polished, the exact radius of curvature was obtained by the reflection of light from the surfaces of the flint lens. This was easily done by means of a tin screen, through which a large pinhole had been made, placed around a light, the rays of which, emerging from the pinhole, impinged upon the concave surface of the lens and were reflected back to an eyepiece placed near the pinhole. The best arrangement was to fix the screen and eyepiece about 4 in. apart, on a piece of board, which could then be placed upon a table and moved back and forth, farther from or near to the lens, as occasion required. It should be noted that the movement of the board should be as nearly as possible in the line of the optical axis of the lens, and that the pinhole and the thread of the eyepiece must be at equal distances from the lens at all times. The tin screen should entirely surround the lamp and be several inches taller than the lamp chimney; and the pinhole should be opposite the bright part of the lamp flame. A low power positive eyepiece should be used, with a fine silk thread placed exactly in its focus. The lens was now focused carefully until a good clear image of the pinhole was obtained, and the distance was then measured from the surface of the lens to the thread of the eyepiece (or the pinhole), which distance represented the actual radius of that surface of the lens.

The radius of III was found to be entirely correct, being 23·50 in.; but that of IIII was slightly longer than the radius of the tool and measured 278 in.

The radii of I and II cannot be obtained in this manner, but as I, II and III were all ground on the same pair of tools, it was safe to assume that all were of the same radius.

The glass had now been formed into lenses of known radii and from them was to be ascertained, by actual trial, their true focal lengths and their optical properties.

The crown lens was then mounted in a tube, and in front of the lens was placed a diaphragm which cut off all the rays of light except a ring or zone about one-quarter inch wide, midway between the center and edge of the lens. The eyepiece with the thread in its focus was used, and the whole carefully focused on a bright star. The focal length was then measured from the middle of the edge of the lens to the thread of the eyepiece, parallel to the optical axis of the lens, and the mean of several trials was 22·82 in. The quantities, I, II and f_1 now being known, μ was found by the following equation to be 1·51480.

$$1 + \frac{I \times II}{(I + II) \times f_1} = \mu \ldots\ldots\ldots\ldots\ldots\ldots (9)$$

$$1 + \frac{23{\cdot}5 \times 23{\cdot}5}{(23{\cdot}5 + 23{\cdot}5) \times 22{\cdot}82} = 1{\cdot}51480$$

The lenses were now mounted together, the surfaces, II and III, being in contact with each other. The focal length, F, of the combined lenses was then measured as before from the same points, and found to be 66·82 in. Then, by the following equation the focal length of the flint lens, f_2, was found to be 34·655 in., thus:

$$\frac{F \times f_1}{F - f_1} = f_2 \ldots\ldots\ldots\ldots\ldots\ldots (10)$$

$$\frac{66{\cdot}82 \times 22{\cdot}82}{66{\cdot}82 - 22{\cdot}82} = 34{\cdot}655$$

and by the following equation μ' was found to be 1·62526.

$$1 + \frac{III \times IIII}{(III + IIII) \times f_2} = \mu' \ldots\ldots\ldots\ldots (11)$$

$$1 + \frac{23{\cdot}5 \times 278{\cdot}}{(23{\cdot}5 + 278{\cdot}) \times 34{\cdot}655} = 1{\cdot}62526$$

The lenses were again mounted in the tube, without the diaphragm, and gradually separated until the color correction was the very best that could be obtained. Great care was exercised in this test, and several different objects were tried—the moon, Jupiter, Saturn, thermometer bulbs in sunshine, etc.—and the separation of the lenses was best effected by means of paper and cardboard rings placed between them. The distance between the lenses was then measured carefully, the mean of several trials being 0·719 in. This showed that the focal length of the crown lens was too long by just the amount of separation required—that is, if f_1 had been 22·101 in., the objective would then have been achromatic when the lenses were in contact. From these quantities, then, $f_1 - d$ and f_2, the ratio of the dispersive powers, δ, was found by the following equation to be 0·63774, thus:

$$\frac{f_1 - d}{f_2} = \delta \ldots\ldots\ldots\ldots\ldots\ldots (12)$$

$$\frac{22{\cdot}82 - 0{\cdot}719}{34{\cdot}655} = 0{\cdot}63774$$

But while, for the purpose of obtaining the ratio of the dispersive powers of the lenses, the focal length of the crown was considered as too long by 0·719 in., on the other hand, the focal length of the crown may be considered as correct and the focal length of the flint as too short by a proportionate amount; and this latter view is the one which will be adopted in the further consideration of the subject.

The reason for this will at once be plain; for while to shorten the focal length of the crown lens involves the regrinding and polishing of two surfaces, the lengthening of the flint lens involves one surface only, that of IIII. It will be evident, too, that the crown lens, being equiconvex, will always be correct in form, and with the lengthening of the flint focus by the increase

TABLE FOR FINDING RADIUS III.

λ	α	β	γ	λ	α	β	γ
·500	1·00273	1·331	·623	·602	1·01050	1·474	·554
·502	1·00300	1·337	·621	·604	1·01047	1·477	·554
·504	1·00327	1·344	·620	·606	1·01045	1·480	·553
·506	1·00354	1·349	·618	·608	1·01042	1·483	·552
·508	1·00381	1·355	·616	·610	1·01038	1·486	·552
·510	1·00408	1·360	·615	·612	1·01034	1·489	·551
·512	1·00434	1·365	·613	·614	1·01029	1·492	·550
·514	1·00461	1·369	·612	·616	1·01024	1·495	·550
·516	1·00487	1·374	·611	·618	1·01018	1·498	·549
·518	1·00512	1·377	·609	·620	1·01013	1·501	·549
·520	1·00538	1·381	·608	·622	1·01007	1·503	·549
·522	1·00563	1·384	·606	·624	1·01000	1·506	·548
·524	1·00588	1·387	·604	·626	1·00994	1·509	·548
·526	1·00612	1·391	·603	·628	1·00987	1·512	·547
·528	1·00636	1·393	·602	·630	1·00980	1·515	·547
·530	1·00659	1·396	·601	·632	1·00974	1·517	·547
·532	1·00682	1·399	·599	·634	1·00966	1·520	·546
·534	1·00705	1·401	·598	·636	1·00958	1·523	·546
·536	1·00727	1·403	·596	·638	1·00952	1·525	·545
·538	1·00748	1·406	·595	·640	1·00945	1·528	·545
·540	1·00768	1·408	·594	·642	1·00938	1·530	·545
·542	1·00788	1·410	·592	·644	1·00931	1·532	·545
·544	1·00808	1·413	·591	·646	1·00925	1·531	·544
·546	1·00826	1·415	·589	·648	1·00919	1·536	·543
·548	1·00844	1·417	·588	·650	1·00912	1·538	·543
·550	1·00861	1·419	·587	·652	1·00906	1·540	·543
·552	1·00878	1·420	·585	·654	1·00902	1·541	·543
·554	1·00894	1·422	·582	·656	1·00897	1·542	·542
·556	1·00909	1·424	·581	·658	1·00893	1·543	·542
·558	1·00923	1·425	·580	·660	1·00890	1·544	·541
·560	1·00937	1·428	·579	·662	1·00887	1·544	·541
·562	1·00950	1·430	·577	·664	1·00886	1·545	·541
·564	1·00962	1·432	·576	·666	1·00884	1·544	·540
·566	1·00973	1·433	·574	·668	1·00884	1·544	·540
·568	1·00984	1·435	·573	·670	1·00885	1·544	·540
·570	1·00991	1·437	·572	·672	1·00887	1·542	·541
·572	1·01003	1·439	·570	·674	1·00890	1·541	·541
·574	1·01011	1·441	·569	·676	1·00894	1·538	·541
·576	1·01018	1·443	·567	·678	1·00899	1·537	·541
·578	1·01025	1·445	·566	·680	1·00906	1·534	·541
·580	1·01031	1·448	·566	·682	1·00914	1·531	·541
·582	1·01036	1·450	·564	·684	1·00924	1·527	·542
·584	1·01041	1·452	·563	·686	1·00935	1·523	·542
·586	1·01044	1·454	·561	·688	1·00947	1·519	·543
·588	1·01047	1·456	·561	·690	1·00962	1·513	·543
·590	1·01050	1·459	·560	·692	1·00978	1·507	·543
·592	1·01051	1·462	·559	·694	1·00997	1·500	·544
·594	1·01052	1·464	·558	·696	1·01017	1·494	·544
·596	1·01053	1·466	·557	·698	1·01039	1·487	·545
·598	1·01052	1·469	·556	·700	1·01063	1·480	·545
·600	1·01051	1·472	·555				

EXPLANATION.—The table is computed for a refractive index of 1·50 for the crown glass and 1·60 for the flint glass.

λ represents the ratio of the dispersions of the two lenses.

α represents the radius of the third surface (III), the unit of measure being 1.

β represents the factor to be multiplied by the variation of the crown index from 1·50.

γ represents the factor to be multiplied by the variation of the flint index from 1·60.

α, β and γ are then to be added together and their sum multiplied by the focal length (f_1) of the crown lens; the result will be radius III.

of radius, IIII, will be correct in focal length also; and the proper separation of the lenses, while effecting the color correction, at the same time brings the surfaces, II and III, into their proper relation with each other to correct the spherical aberration.

The optical properties of lenses were now all known quantities, and it remained to compute the distance, d, by which the lenses were to be separated, the focal length of the flint lens in order that it may be proportional to the ratio of the dispersive powers, δ, and the radius of IIII to produce this focal length.

First, then by Eq. 1, λ was found to be 0·52517, thus:

$$0·63774 \times \frac{0·51480}{0·62526} = 0·52517$$

and with this as the argument the quantities α (1·00601) β (1·369) and γ (0·935) were taken from the table and the distance between the lenses, d, was found by the following equation to be 0·2696 in., thus:

$$f_1 - \frac{II}{[\alpha + (\beta \times \mu - 1·50) + (\gamma \times \mu' - 1·60)]} = d \quad \ldots (13)$$

thus:

$$22·82 - \frac{23·5}{1·00601 + 0·02083 + 0·01527} = 0·2696.$$

Then, by this equation, f_2 was found to be 35·3598 in., thus:

$$\frac{f_1 - d}{\delta} = f_2 \ldots\ldots\ldots\ldots \quad (14)$$

$$\frac{22·82 - 0·2696}{0·63774} = 35·3598$$

and by Eq. 7, IIII was found to be 373·52, thus:

$$\frac{23·5 \times 135·3598 \times 0·02520}{23·5 - 135·3598 \times 0·02520} = 373·52$$

while the focal length of the objective, F, was found to be 62·249, thus:

$$\frac{f_2 \times (f_1 - d)}{f_2 - (f_1 - d)} = F \ldots\ldots\ldots\ldots \quad (15)$$

$$\frac{35·3598 \times 22·5504}{35·3598 - 22·5504} = 62·249.$$

Therefore, we have:

I, II, III	23·50	in.
IIII.	373·52	"
f_1	22·82	"
f_2	35·3598	"
F	62·2490	"
d	0·2696	"
μ	1·51489	"
μ'	1·62526	"
δ	0·63774	"

The back surface of the flint lens IIII was then reground and polished, figuring of any kind having been carefully avoided, the object being to keep the surfaces as nearly as possible to the computed curves; after which the objective was tested and proved even at this stage of completion to be very nearly correct. The objective was then finished by figuring where necessary, and has since proved to be most satisfactory in its performance.

METHODS OF DETERMINING THE ECONOMIC PRODUCTIVITY OF MUNICIPAL ENTERPRISES.*

THIS topic must be defined and limited before it can be profitably discussed. Obviously, it does not cover all municipal enterprises. No practical object would be gained by a discussion of the economic productivity of roads or parks or sewers or police. It is needless to justify what everyone accepts. On the other hand, there are classes of municipal enterprises the economic productivity of which is a matter of controversy. Means of transportation within the municipality or public docks may serve as examples. If a municipal enterprise aims primarily at rendering an economic service, it may fairly be tested by its economic productivity, but otherwise not. Certain municipal enterprises are merely or mainly devices for rendering economic services cheaply and well. Their efficiency must be determined by comparing them with other devices for rendering equivalent services. The latter may be divided into private enterprises regulated mainly by competition and private enterprises regulated both by competition and by governmental interference. This leads to a final limitation of the question, viz., the methods of comparing the economic productivity of municipal enterprises aiming at economic production with private enterprises rendering similar services and more or less subject to governmental control. It may be noticed in passing that the final decision upon the wisdom or folly of such municipal enterprises must be influenced by many considerations besides the economic productivity of the ventures. The general theory of our law and political science is adverse to a wide extension of the functions of municipalities in such directions. The not infrequent corruption and the more frequent incompetency of our city governments are practical arguments in favor of the same position. On the contrary, the high-handed procedure of many corporations holding public franchises, an argument entirely aside from the present phase of the subject, is yet of great, perhaps of decisive, weight in forming the final conclusion.

The economic productivity of municipal enterprises may be measured only by comparing their efficiency with that of similar private enterprises. But the two have diverse ends in view. The aim of a municipal enterprise is to satisfy the voters; the aim of a private plant is to earn money for the corporation. Hence they are not likely to render the same service, except occasionally and by accident. To be sure, one most important means of pleasing the voters is by convincing them that their money is being saved and their taxes reduced. But perhaps as many voters would be influenced by a policy of generous or lavish display as by a favorable balance sheet. So, too, a most important means of earning money for a corporation is by pleasing not necessarily all the voters, but the patrons and possible patrons.

The fact remains, however, that the primary object in the two cases is different and that we cannot compare the economies of the two systems until one or the other of these ends or some intermediate one is made our standard. Perhaps we may say that the primary end is to protect the capital invested, whether private or public, and, if it be private, to secure a reasonable return upon what has been necessarily and legitimately expended, and that the further end is to render a satisfactory service to the consumers, who may often be substantially the entire public. If this be admitted, it follows that the true end is not that of the ordinary corporation or of the ordinary municipal enterprise, and that the former is likely to neglect the interests of the consumers and the latter to risk the capital of the taxpayers. Furthermore, the consumers may be grouped into two classes, the municipality as a body and the private citizens as individuals, and the balance must be held between these two interests, which are often antagonistic. It is not, I believe, uncommon for a private corporation seeking a contract or franchise to offer unduly favorable terms to the municipality and recoup itself for losses thus incurred by unduly high prices to individual patrons. Municipal enterprises, on the contrary, are tempted to close contracts with private patrons at a losing figure and let the municipality as a whole make up the losses.

The arguments upon the profitableness of municipal ownership differ so widely in the various enterprises that a statistical examination must lose in thoroughness and range if it seeks to include several classes under a single investigation. From the point of view of method, therefore, it would seem better to make a separate statistical study for each industry affording the requisite information. For this purpose gas lighting has been chosen as the one upon which the greatest amount of trustworthy information is available. The facts regarding the gas companies of Massachusetts have been gathered now for ten years, and evidence of certain changes may be derived from a collation of the facts contained in the eleven annual reports of the board of gas and electric light commissioners of that State. I may briefly recapitulate the changes which by way of extended illustration have been shown to have occurred, and presumably to be still progressing in Massachusetts, and not improbably elsewhere under the system of private control subject to state supervision.

(1) The manufacture of coal gas increased five-sixths in nine years.

(2) The proportion of this gas unaccounted for, and so attributable to leakage, has fallen to about three-fifths of what it was eight years ago.

(3) The quality of the gas has improved, especially in the case of the larger companies.

(4) The number of high power gas lamps and of gas stoves has been rapidly increasing.

(5) Meanwhile the number of public gas lights has fallen about two-fifths.

(6) The price of gas has been falling, especially among the larger companies.

(7) The proportion of the cost of coal obtained from the sale of residuals has been rising.

Now the point upon which emphasis is to be laid is that the changes to which every sort of enterprise is subject, and of which the foregoing are illustrations, are of far greater importance in the determination of its real economic productivity than the condition of that business at any point of time. Assume for the moment that all these gas companies had been managed for the last decade as municipal enterprises, would the same changes have taken place? If not, would those that did occur have resulted in a greater or in a less economic productivity? Such questions, it appears to me, are speculative and will be answered by every one in accordance with preconceived ideas or theoretical arguments. I see no way in which to wring a conclusive answer to them from experience. Accordingly the answer which as a statistician rather than a theorist I am compelled to make to the question at issue is, in the first place, that until municipal enterprises have had a longer history, and the facts have been gathered and presented in a shape suitable for comparison, no method of determining their economic productivity will give convincing results, and that, secondly, when the facts are obtainable, the conclusions must be drawn from the changes which are fostered by the various systems, and that the conditions prevailing under any one at a particular time must be deemed of subsidiary importance.

* Prof. Walter F. Willcox, of Cornell University, in the American Journal of Sociology, Chicago, November. Condensed for Public Opinion.

A PROFITABLE SPECIALTY—THE MANUFACTURE AND SALE OF FURNITURE POLISH.

LEON L. WALTERS points out (American Druggist) the fact that there are many widely used preparations the manufacture of which comes directly within the province of the pharmacist, and which, if properly pursued, become sources of very considerable trade and profit, and which tend greatly to offset the loss of trade in toilet articles, stationery and the like resulting from the fierce, and in many instances unfair, competition of department and other stores.

Prominent among the means that are open to almost every druggist as a profitable addition to his business is the making and selling of

FURNITURE POLISHES AND CREAMS.

The amount of these preparations used annually is very considerable, and with a little effort there is no reason why the druggist should not be able to command at least a portion of this trade.

The polishes most generally sold vary widely in their composition and utility, and it is difficult to devise a formula for any one polish to give uniform satisfaction. Formulas are, therefore, given for a number of polishes and creams, any one of which produces a tolerably good article.

Perhaps the most widely known and generally used

of furniture polishes is the one commonly designated as

"CHEMICAL POLISH."

	Parts.
Linseed oil	40
Alcohol	4
Vinegar	16
Antimony chloride	2
Ammonium chloride	1
Spirits of camphor	1

Place the oil in a large bottle, and add successively the antimony chloride, the spirits of camphor, the vinegar and the alcohol, part by part, and with constant shaking; when thoroughly incorporated, add the sal ammoniac.

This, perhaps, as an "all round" polish gives better satisfaction than any other. The following simpler formula has, however, during a trial of some four years proved very satisfactory. It is sometimes sold as

ACME FURNITURE POLISH.

Boiled linseed oil	4 pints.
Alcohol	2 "
Turpentine	1½ "
Antimony terchloride solution	10 drachms.

Mix the linseed oil and the turpentine; dissolve the antimony terchloride in the alcohol and add to the oil and turpentine little by little, shaking after each addition.

As a fair sample of polishes containing acids, the following may be taken:

ACID POLISH.

Boiled linseed oil	4 ounces.
Alcohol	3 "
Hydrochloric acid	2 drachms.
Red sanders, q. s. to color.	

Mix the oil with the alcohol; then add the acid with constant shaking.

As a renovating polish, the above is widely used. It should be shaken up before being used.

Pastes and creams, on account of their cleanliness and ease of application, are coming to be quite generally used. The formula given below produces an article that will compare more than favorably with any now on the market:

FURNITURE CREAM.

White soap	2½ ounces.
Spirits turpentine	80 "
White wax	20 "
Water	110 "
Carbonate potash	1 "

Place the soap in a water bath with a portion of the water and melt by a gentle heat, adding the remaining water as fast as absorbed. Now add the wax and increase the heat until it melts. Reduce the heat and add the turpentine gradually, stirring until all is thoroughly incorporated.

This produces an elegant article, which sells rapidly and gives even satisfaction. It should be put up in one and a half and two ounce ointment jars properly labeled.

THE SELLING OF THEM.

Two fields are open for the sale of the above: First, at retail to local trade and, second, in quantities to furniture dealers. For local trade there are two seasons in which special effort should be made to push the sale of the above, namely, during spring and fall house cleanings. At these times the judicious use of window displays, combined with appropriate, neat and striking signs, will be of great service. But of all the means at hand for calling your customers' attention to the fact that you make such preparations, perhaps the most efficient consists in the printing of a brief little folder with reference to furniture polishes alone. Such a folder, of say four pages (two double pages), costs but comparatively little, and, if properly composed, the results fully merit the outlay. Make it brief and concise, stating clearly and succinctly the good points of your polish, directions for its use, with a little explanation as to just why the druggist, above all others, is best fitted to know what constitutes a good furniture polish, and why he is eminently qualified to make it. During the seasons mentioned an admirable plan for distributing the folders is to inclose one in each package as it is made up. When thus carried out this method, combined with a judicious personal recommendation to customers while in the store, will seldom fail of the desired end.

The supplying of dealers with polishes of various kinds opens up a new field to many druggists. Every furniture dealer uses yearly a considerable quantity of furniture polishes and creams, which, as a rule, he buys from his wholesale dealer in bulk. I know of one druggist who derived a considerable revenue from supplying polishes to the furniture trade of his town, and there is no reason why others should not be equally as successful. Make up a small quantity of each of the different polishes for which formulas are given and send a sample of each to the furniture dealers of your city, accompanied by a circular telling of the advantages to be derived from purchasing his polishes from you, with an offer of putting them up to suit his trade. Such a letter, if properly worded and accompanied by the samples mentioned, seldom fails of a favorable reply. The manufacture of the polish need not detract in the slightest degree from the usual business of the druggist. The preparations can be made at leisure, and, what is more, they serve as a vehicle for the employment of discarded alcohol, such as has been used in the cleaning of mortars and the like, and which otherwise is of little value.

The charges upon cotton in New Orleans for storage and compressing are the same as those governing the trade last year, says the Textile World. We select the following charges, as they will be of interest to some of our readers: Storage for first thirty days on compressed cotton, 15 cents; extra charge for every additional thirty days, or part thereof, 8 cents; compressing, per bale, 30 cents; compressing and drayage to and from press, per bale, 60 cents; turning over cotton for marking, per bale, 3 cents; extra bands, 5 cents each; sample bale covering, per bale, 2 cents; sewing up heads, per bale, 3 cents.

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ELECTRIC LOCOMOTIVE FOR MINES.

THE uses of electricity in mining are being extended continuously, and for propelling cars in mines electric locomotives present great advantages. One of the first applications of electricity as a propelling power on a commercial scale was made in the mines of the Harz Mountains, in Germany, by the well known firm of Siemens & Halske.

Our cuts show the electric mining locomotive constructed by the Union Elektricitäts-Gesellschaft, of Berlin, Germany. The compact arrangement of parts enables these engines to pass through narrow places, and uniformity of the exterior dimensions is preserved for engines of various powers, so that a 4 horse power engine is exactly like a 26 horse power engine in outward appearance. The outer frame is so constructed that it will receive motors of various powers, so that the design of the frame and its size are the same for all engines. The wheels can be shifted on their axles so that the engine will operate on railways of any gage from 490 millimeters (1 foot 8 inches) up to 650 millimeters (2 feet 1⅝ inches). As the gage used in mining railways varies, the adjustability of the wheels is a very useful feature.

The locomotive consists of a cast iron frame reinforced by flanges and supported on the axles by coiled springs. The motors are carefully incased, and have on their casings rearward projections forming bearings for the wheel axles. The connection between the motor shafts and the wheel axles is made by incased gearing. The switch for controlling the speed, starting the engine and reversing the motors is located at the top, near the end of the engine, so as to be readily accessible and yet occupy little room. The connecting wires are inclosed in tubes screwed upon the frame and are thus protected against injury by moisture or from other causes.

In the center of the engine is the contact arm carrying the trolley. This arm can move up and down to a considerable extent, so as to readily follow the line of the overhead conductor. When the rails can be used to form the return circuit, one trolley arm is employed; in other cases the engine is provided with two trolley arms. Sand is used to increase the adhesion of the wheels to the rails if necessary. A powerful hand brake serves to stop the engine and train.

Our third cut shows a 12 horse power engine with wheels adjustable to a minimum gage of 490 millimeters (1 foot 6 inches). The other cuts represent a 100 horse power engine developing a pull of 2,500 kilogrammes (5,500 pounds) at a speed of 2.5 to 3 meters (8 feet to 9 feet 10 inches) per second. The engine weighs 18,000 kilogrammes (40,000 pounds), and is shown as running upon a railway of 700 millimeters (2 feet 11½ inches) gage. For the engravings we are indebted to Der Stein der Weisen.

ELECTRIC PUMPS FOR BOILERS.

A RECENT article in L'Electricien, says the Western Electrician, by M. P. Simon, discusses at considerable length the question of water feed for steam boilers, dividing the necessities of the case under three heads. These are:

First. The water should be both chemically and mechanically as pure as possible.

Second. It should be fed into the boiler at as high a temperature as possible, being heated by waste steam only.

Third.—The feeding apparatus should be simple, economical and little liable to derangement or accident.

The third factor in the case appears to be open to more thorough discussion than the two former. In considering methods there seem to be but two which have place in the discussion—injectors and pumps.

The injector is open to serious objections. Its first cost is high. It can only be used economically with cold water; the quantity of water it is capable of handling is nearly a quite a fixed amount. If the water is heated for the injector it is expensive because of the loss of steam used for this purpose. In addition to these objections, the injector sometimes gets out of order, and requires time, during which the boiler must be supplied by another means, to repair, as it is at best a rather delicate piece of apparatus, though not very complicated.

Pumps, on the contrary, are extremely varied, of all forms, sizes and action. They are readily changed to suit all circumstances. The rated output may be doubled or trebled with ease, they will handle hot as well as cold water without difficulty. The system is capable of the greatest flexibility with the least inconvenience.

Where these are actuated directly by a pumping engine there is more work done at times than is required and the overflow runs back into the tank, making a loss of that much power. This sometimes amounts to two or three times the power utilized.

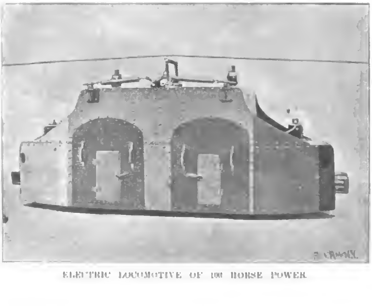
Putting these steam-driven pumps on a multiple system of boilers, where several are fed from one source, the complication of pipes, valves, etc., becomes burdensome and objectionable. When the pump is actuated by a driving belt, in case of constant demand and continuous supply, the same objections obtain. In general, an independent power supply is preferable, as indicated by the great number of donkey engines in use for such service.

But the engines consume an amount of power entirely disproportioned to the good achieved. This is not to be wondered at. As a rule, the smaller the machine, the less the efficiency. The author cites a pump which requires 400 kilogrammes of steam to produce one horse power of work.

There is an electrical method of disposing of the question. A motor, shunt wound, having a field rheostat, can be run at varying speeds and regulated with great precision by means of the adjusting coils. It will impart motion either through direct coupling or belting. One of these in service, operating a three-cylinder pump, is capable of most perfect regulation between very large limits. There are no shocks, the traction on the pulley is regular and constant. Such a pump has taken the place of a steam pump which consumed, according to circumstances, from 30 to 75 kilogrammes of steam per hour, while feeding the boiler with 600 kilogrammes of water. The horse power expense theoretically varies, then, between 180 and 340 kilogrammes of steam. Per contra, the electric motor which supplanted the engine absorbs six amperes at 110 volts, or 660 watts, which costs hardly 10 kilogrammes of steam. The economy is nearly 10 per cent. in coal consumed. Another instance is given where a similar application of electric power has effected a saving of 14 per cent. In addition to this there is a large economy in the item of oil by the electric system, which averages about 87 per cent.

A system of feeders for several boilers actuated by a single motor is suggested. A small reservoir is placed between the pump and the feedpipe running to the several boilers, each of which is fitted with a check valve and an indicator. There is no waste of steam or power, and the whole operation of water feed is made perfectly automatic and thoroughly economical. With no demand on the reservoir, the motor stops and the pump is still.

ELECTRIC LOCOMOTIVE OF 100 HORSE POWER.



ELECTRIC LOCOMOTIVE OF 100 HORSE POWER.

ON THE CONSTITUTION OF THE ELECTRIC SPARK.*

IF a Leyden jar is discharged through metal electrodes, and the spectrum of the spark is examined, it is found that the metallic lines are not confined to the immediate neighborhood of the poles, but are seen sometimes in the center of the spark, several millimeters away from the electrodes, from which they must have been projected with considerable velocity.

It has always seemed to me to be a problem of interest to measure the velocity of projection. A knowledge of it may teach us something concerning the mechanism of electric sparks and, in addition, we may hope to obtain information on some important points in spectrum analysis, which are at present under discussion. Thus, for instance, if the speed with which a molecule is pushed forward into the center of the spark depends on molecular weight, we may separate from each other those lines of the spectrum which belong to different molecular combinations. For many years past I had made various unsuccessful attempts to deal with this problem, when I became acquainted with the elegant method used by Prof. Dixon in some of his recent experiments, in which a photograph is taken on a film fixed to the rim of a rapidly revolving wheel, of which the speed may easily be made sufficiently large to measure velocities of moving luminous particles up to 2,000 $\frac{\text{meters}}{\text{second}}$. This number might be doubled or trebled with improved appliances.

The experiments were conducted by Mr. Gustav Hemsalech, to whose care and skill their success is largely due. Without entering into a detailed description of the apparatus, it will be sufficient to say that the photographs, which I now sub-

* By Prof. Arthur Schuster, F.R.S. (Read before Section A of the British Association at the Toronto meeting.)

on a strip of cloth soaked in polishing powder boiled in water, the cloth being firmly fixed at one end and held at the other in the left hand. The hollow parts are polished by means of cloth pads of various sizes fixed on sticks. These pads must be dipped in the polishing paste when using them. The articles, when well brightened, are washed in water to get rid of the paste and the wool threads, and finally dried in sawdust.

THE GLASGOW CABLE RAILWAY.

AT the beginning of the present year the walls of Glasgow were covered with immense illustrated posters announcing the setting in operation of a district subway of an underground railway, "the only subterranean cable railway in the world, without steam or smoke, having a perfect system of ventilation, permitting of making the circuit of the city in half an hour, and carrying passengers from one station to another in two and a half minutes."

FIG. 1.—INTERIOR VIEW OF ONE OF THE TUNNELS OF THE GLASGOW RAILWAY.

The fact is that Glasgow, like Budapest, imitating cities of larger size, is giving Paris a good example to follow in the possession of a railway that is at present rendering the greatest service to city travel.

A mere glance at a plan of Glasgow will show that the city, inclusive of its outlying wards, is divided in two by a river, the Clyde, which is much deeper than the Seine, and the bed of which is formed principally of sand and gravel. Finally, let us add that, in addition to the difficulties resulting from the watersoaked nature of the ground, there were found pockets of water in old quarries, and it became necessary also to construct retaining work in some abandoned mines that had to be traversed.

The line under consideration is circular, but is not located at the periphery of the city, as such a position would render it perfectly useless. It was desired principally to connect the western quarters, Millhead and Partick, and especially those which, like Govan, are so much the more isolated in that they are on the other side of the port, with the heart of the city and the central station of the railways. The service had to be as frequent as that of tramways, and afford a speed of from 11 to 12 miles an hour, inclusive of stoppages. The extent of the circle which is thus described is about six miles, which is considerable in view of the fact that the establishment of this line was not decided upon until 1890 and that it has been in full operation since the beginning of 1897.

The road is provided with two tracks, each in a separate tunnel, so as to diminish the cubage of the excavation and to facilitate the ventilation by the passage of trains always in the same direction.

These tunnels are cylindrical tubes of brick and concrete or of metal, of 11 ft. internal diameter, separated by a space varying from 30 in. to 6 ft. in width. The metallic rings are made of segments of cast iron provided at the circumference with flanges that permitted of assemblage by bolts, the joints being rendered tight through the interposition of oak. A system of drainage is provided all along the two tunnels in order to carry off the water, which at certain points is raised by pumps. The stations, which are fifteen in number, are sufficient for a length of 6 miles, since this supposes them to be very near each other on an average. Several get their light from the exterior, through glass overhead. Certain of them, in fact, are at such a depth only that the rail is at a level of 13 ft. from the surface of the street. With others, the corresponding distance reaches, as at Buchanan Street, 39 ft. or over. As a general thing, the passengers who descend from the street to the platform by special stairways have to travel a vertical distance of about 19 ft. Electric elevators, however, are in course of construction at Buchanan Street and Saint George's Cross, the two deepest stations. For each station there is a single platform, which is situated between the two tracks and rises to the level of the floor of the cars, according to the excellent English method. It is to be remarked that upon this line, in which gradients have been almost completely avoided save at the double passage of the Clyde, each track presents an incline of $\frac{1}{16}$ at the entrance to the stations and a like one at the exit therefrom.

This is, on the one hand, for facilitating the stoppage of the trains and seconding the action of the brakes, and, on the other, for rendering the starting easier and suppressing all abnormal strain upon the cable.

Before speaking of the latter, of the exploitation and of the rolling stock, let us say a word as to the excavation of the double tunnel. This was established in part only by means of a shield, say for about a third of its length, and where it is now formed of iron segments; but in the sections where it could be made of brick and concrete, the contractors, Messrs. Simpson & Wilson, had to use a great deal of ingenuity in order to contend against moving earth and the influx of water and to protect the buildings and even the railways under which the work had to pass. Sometimes, as with the ground in the vicinity of the Clyde, it was possible to proceed according to the system called "cut and cover," that is to say, to establish a cutting in which were constructed in the open air the invert, the lateral walls and the vault. At least 140 running feet were constructed per month. At the Cowcaddens station the method employed was one that was devised long ago at Glasgow for other work and imitated at Paris for the Sceaux Railway.

This consisted in making an excavation sufficient for constructing the vaults upon a mass of earth performing the role of centerings and then finishing the work subterraneously. The work was complicated in that the running of the surface tramway cars could be interrupted for only a short space of time and at night, and that it was necessary to support a huge water main above the cutting. At certain points the vaults could be constructed in the same way, but the work had to be completed with compressed air and air locks, in effecting a great saving over iron tubing, although the compressed air escaped in large quantities through the earth. Sometimes recourse was had to the iron tunnel, but without compressed air, when impermeable strata were traversed and it was desired to avoid any ramming at the surface. Shields were also employed, and these had the advantage of sustaining the mass of earth during the excavation and the putting in place of the iron segments. Naturally, also, the shield and compressed air were used simultaneously at the different points where the ground was watersoaked—in the crossing of the Clyde, for example. Here, since the depth under the river bed was slight, the compressed air often forced its way through the bed and made a hole therein which it was very difficult to fill up. It became necessary to set up framework in front of the shield, and to regulate the pressure of the air according to the height of the water in the river, etc. Upon the whole, all the difficulties were surmounted with a skill that does honor to the engineers and contractors who brought the work to a successful finish.

We have said that the propulsion is by cable. It is assured by two central 1,500 horse power engines, of which only one is operating. At present, since the traffic is as yet small, only 400 horse power is used. The cables, which run all along the track over vertical sheaves, and are tautened at the extremities by a special apparatus, are 1·3 in. in diameter. Each of them weighs 58 tons. The cars are attached thereto by a grip that can be opened instantaneously. These cars are very long and are mounted upon trucks. They run upon a track of 4 ft. gage. The interior is plain, but sufficiently comfortable. They are lighted by means of electric lamps that take a current from a conductor fixed to the wall of the tunnel. They have a platform at each extremity, with two entrances only, these being sufficient for a population which is capable of "making haste slowly." They have sufficient capacity to seat 42 persons and allow standing room for as many more.

In conclusion we may say that at present there are but eight cars running simultaneously upon each circular track. This, however, gives one train every five minutes. At first, the cars were run from eight o'clock in the morning until eight at night, but the success of the line quickly forced the management to run them from a quarter past seven till a quarter past eleven. It has been recently stated that trains of two cars are soon to be put in service.

The cost of the railway was not so very high, since the total expense of establishment, inclusive of the rolling stock and central power house, was but £1,100,000. —La Nature.

A TUBE TUNNEL UNDER THE SPREE.

A TUNNEL possessed of some interest from a technical point of view—more, perhaps, in connection with the condition of the soil (sand) through which it is being carried than as regards its actual construction—is at present being built under the River Spree, between Stralau and the Treptow Park, where the exhibition was held, and for which purpose it was originally intended. The tube tunnel has a length of about 1,510 feet, the breadth of the river being about 670 feet, the depth on that spot 11 feet, and the bottom of the tunnel some 25 feet lower than the bottom of the river. The inside diameter of the tube is 13 feet, and the tube itself is circular. The tube consists of rings of about 2 feet breadth, made up of nine pieces; these are of pressed steel, and connected by means of bolts. The tunnel tube is surrounded by a layer of cement, the thickness of the steel plate and the protecting cement layer being respectively 10 and 80 millimeters. The permanent road inside the tunnel is also made of concrete. The shield, in which the workmen are, is a tube of somewhat larger dimensions than the tunnel itself; and it is pressed forward by hydraulic pressure, its front end being beveled so as to be better able to cut its way through the soil. The front of the chamber, in which the men work in compressed air, has apertures, which can be closed airtight, through which the soil can be worked and loosened. The working chamber is divided into two compartments; the men in the outer are employed in removing the soil, while the cementing is done in the second. The average progress is some 2 feet to 3 feet per day, although about twice the distance has been compassed when special pressure has been put on. So far everything in connection with the undertaking has worked satisfactorily.—Engineering.

The experiment of double rudders on warships has produced such altogether unsatisfactory results that those now in use will be taken off at once, and no more will be tried. Two rudders, one forward of the other, were put on the gunboats Helena and Wilmington, the remarkably light draught of those vessels giving little room for attaching one good sized rudder, and as these vessels were also designed for maneuvering in narrow river channels, the twin steering expedient was adopted to increase their obedience to the helm. On their sea trials these vessels were found to steer admirably at full speed, but when they dropped to four or five knots, which is deemed a good river rate, the men at the wheel lost all control of them, and they could not be made to respond to the helm. In subsequent trials the forward rudder was fastened straight astern, and immediately it was found that the ship behaved admirably. Orders have therefore gone to New York, where the Helena is in dock, to take off the forward rudder and fill in the hole it occupied, and the Wilmington, which was on the point of sailing for Montevideo, will be sent to the Norfolk yard in a day or two for the same alterations, which will delay her at least twelve days.

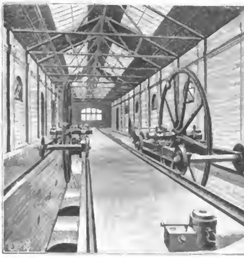


FIG. 2.—MACHINERY FOR TAUTENING THE CABLES.

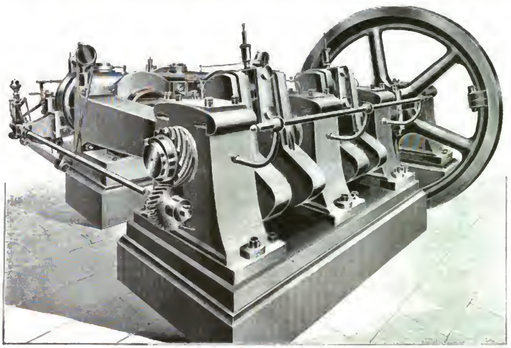
A MODERN GAS POWER PLANT.

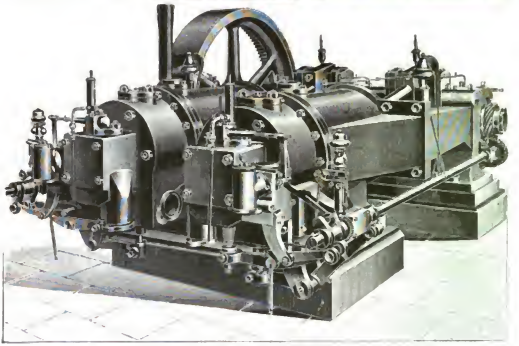
By HORACE ALLEN, C.E.

THE gas generator plant reported on below is of 300 horse power capacity, and works on the Thwaite patent continuous cycle. The apparatus consists of two cylindrical vessels side by side. The fuel is fed into the hopper at the top, and air is supplied by a fan driven from the main engine. The gas, as it leaves the bottom of the second generator, has a high temperature, and is made to heat the incoming air by means of a recuperator apparatus, thus restoring a considerable amount of heat to the generators. From the recuperators the gas passes through a physical purifier to the pressure governor holder, which automatically governs the supply of gas to balance the demand, and from which the gas engine receives its supply. The analyses of the gas, and its thermal value, prove the excellence of the system.

The gas engine, made by Messrs. Hartley & Petyt, is of the duplex type, having two cylinders 16 in. diameter, side by side, the length of the stroke being 2 ft.; and as they are arranged for the Otto cycle, there is one firing stroke every revolution when fully loaded. The speed is 140 revolutions per minute. The charge of gas and air is compressed to about 80 lb. per square inch above the atmosphere, and the pressure of the explosion is about 300 lb. per square inch above the atmosphere. To facilitate the starting of the engine it is necessary to reduce the pressure due to compression; for this purpose a cam is provided which allows a portion of the charge to escape into the exhaust. The design is thoroughly mechanical, and the physical proportions of the machine are adequate for their purpose. There is so little vibration that a penny stood on edge on the cylinder, either lengthwise with the engine or crosswise, was not shaken down. The photograph shows the teeth on the fly wheel into which the pinion of the small starting engine gears; this engine is of the vertical type, having a cylinder 8 in. diameter.

The balancing of the crank has produced very steady turning, the timing valve is simplicity itself, and the best point of firing can be instantly ascertained. The lubrication is on the circulating principle, a small pump effecting this. Both tube and electric ignition gear are applied to the engine. The engine house is covered with a water tank, which feeds the circulating mains of the engine. The hot water is used in the dye vats, so that there is no loss of heat from this source. Another heat loss of ordinary plants is that of the sensible heat of the gases evolved from the gas generators. In the plant under consideration this heat, representing 30 per cent. of the total heat of the fuel, is restored for two purposes, one of which is the drying of the textile materials—an important industrial function—and the other is the restoration of the heat to warm the air used in the gasification process, and for the purpose of increasing its moisture absorbing characteristics; this last development is covered by one of the Thwaite patents.—The Engineer.





ONE HUNDRED AND FORTY HORSE POWER DUPLEX GAS ENGINE.

WORKING AND HARDENING STEEL.

"NEARLY all persons, in writing on the proper method of working steel, lay too much stress on overheating, or what they term 'burning steel.' During my experience, I have found that there are more steel tools destroyed by working too cold, or improperly manipulating on the anvil, than from any other cause. The uninitiated have heard so much about burning steel that they are really afraid to bring a piece of steel to the proper heat for forging purposes. I have often seen the novice working steel down to a black heat under the steam hammer, not only destroying the structure of the steel, but the hammer dies also.

"A man working at the fire next to mine continually had complaints coming to him about his tools being burnt, in fact, his tools would come back broken off about one half inch from the point, showing a coarse, black structure, similar to a piece of overheated or disintegrated steel. The poor fellow was hammering away on cold steel all day long. Finally he said to me, 'Why is it that they all tell me that my tools are all burnt, when I work them at a much lower heat than you do; yours do not break short, mine do.' I told him that his tools were not burnt, but improperly manipulated on the anvil, i. e., worked too cold, and not properly hardened after being brought to the proper shape. He replied: 'If I were to bring steel to the heat you do, they would all break off about three-fourths inch from the point.' He then showed me many of his tools broken off as described. I examined the tools which were not broken, and which had given good service after the last dressing, and found that nearly all of them had been reinforced about three-fourths inch back from the point; this compression is almost imperceptible to the naked eye, but can easily be felt by passing this part of the tool between the thumb and finger. I informed him that the next time he dressed those tools they would break at the point mentioned as soon as put in service, and show a dark, coarse structure, similar to overheated steel; the men using the tools would upbraid him for burning the tools.

"The cause of so many tools breaking at this point is improper hardening, or rather, the hardening and tempering are done too quickly, leaving a hard and soft section in conjunction with each other; consequently, the hard section is driven into the soft, displacing the

original structure at this point and making it unfit for any purpose; unless the piece is cut off at this point when dressed, it is liable to break off by dropping on the floor. To avoid this, heat your steel sufficiently to harden the whole length of the taper point, and retain heat enough in the body of the tool to draw the temper slowly; if the tempering is done too rapidly, or the blue color allowed to run too fast, then submerge in water to stop its further progress. At the junction of the bright and blue color the hard and soft section is formed with the above results. The color should run very slowly, so as not to produce any sudden change in the structure of the steel when tempering. The above articles refer to tools that are subject to impact force or heavy blows, such as stone cutter's tools, chipping chisels, etc.

"Improper manipulation in forging causes many imperfections in steel tools. When the piece to be forged is of uneven shape, the force of the blow from the hammer must be governed by the section of the piece it is shaping. In nine cases out of ten, where chisels are found cracked on the corner, it is caused by striking the edge of the chisel when too cold, causing compression to take place a little below the surface that received the blow. Some persons claim that these cracks are caused by uneven heating before hardening; others call them 'fire cracks.' Admitting the fact that uneven heating will produce similar flaws to those referred to, my experience has taught me that they are mostly caused by improper hammering on the anvil.

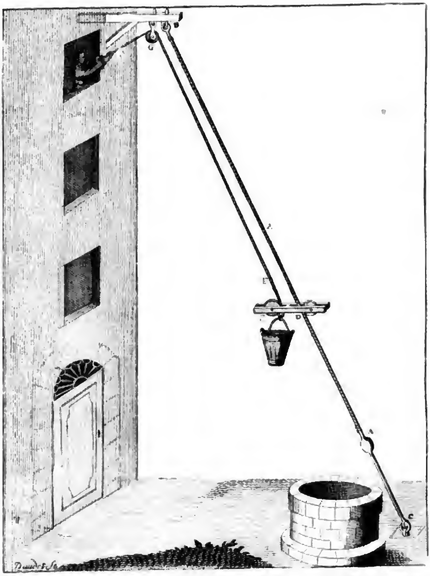
"Steel tools that have to be finished in the lathe or planer, such as taps, dies, milling tools, etc., great care should be taken in forging. If the steel has to be reduced from a large to a small section, bring the steel to a bright red heat for the purpose. Every blow struck should affect the piece from surface to center; if the piece is worked too cold, the blows affect the piece only partially through its section, causing two structures in the same piece; consequently, the uneven structure will maintain itself through all the operations in finishing the tool, and when completed it will not give satisfaction. This class of tools, after being finished, will come back to the smith to be hardened.

"The conditions in heating steel for forging purposes and heating finished tools for hardening are vastly different: in the latter case great care must be taken in [illegible] whole piece to be hardened should be [illegible] and uniformly over the whole piece, as [illegible] harden at a lower heat than others. The [illegible]now, before heating a costly tool, the necessary heat, when plunged into water, to produce the hardness required; overheating in this case means destruction to a costly tool. If it is a complicated tool, having delicate projections, baths should be prepared, which are not as good conductors of heat as the bath for ordinary purposes, as the slender projections will cool much more rapidly than the body of the piece. Oil is often used for this purpose, but any liquid will answer that will give the thin projections sufficient time to cool, at the same time producing the hardness required. We should always bear in mind that it is the time it takes a piece of steel to cool that determines its hardness, other conditions being equal."—President Wren, at Convention of National Railroad Master Blacksmiths' Association.

VERY CONVENIENT MACHINE FOR DRAWING WATER FROM A WELL REMOTE FROM THE HOUSE THROUGH A FIRST OR SECOND STORY WINDOW.

AFTER stretching the rope, A, as tightly as possible from the point, A, beneath the window, to the point, C, near the well, and after passing the rope over the pulley, D, so that the latter can roll freely up and down, the rope, F, that carries the bucket is passed over the pulley, E, and then over the pulley, G.

In this way, in measure as one slackens the rope, F, the bucket, through the pulleys, D and E, that follow it, will descend diagonally from the window to a point above the well, where the pulley, D, will meet with a knot, A, in the rope, and will stop there along with the pulley, E. Then, in continuing to slacken the rope, F, the bucket will be made to enter the well, into which it will descend perpendicularly in order to draw up water therefrom. Upon the rope, F, being pulled after the bucket has been filled, the latter will ascend perpendicularly from the bottom of the well to the knot, A, and then diagonally, along with the pulleys, D and E, from the knot up to the window.—From Recueil d'Ouvrages Curieux de Mathematique et de Mécanique, 1733.



VERY CONVENIENT MACHINE FOR DRAWING WATER FROM A WELL REMOTE FROM THE HOUSE THROUGH THE WINDOW OF THE FIRST OR SECOND STORY.

IN tearing up a siding on the Straitsville Division of the Baltimore and Ohio Railroad, the other day, the section men discovered that several of the rails had been made in 1863. Subsequent investigation revealed the fact that these rails were part of a lot that were bought in England during the war, at a cost of $125 per ton in gold. The rails were still in very fair condition, and for light motive power might last ten years longer.

KEITH'S AUTOMATIC LIQUID ELEVATOR.

AT the recent Brewers' Exhibition, in London, a new device for forcing beer to the delivery faucet was shown. This device is Keith's automatic liquid elevator, which has been successfully applied to the raising of beer under pressure, as opposed to pumping by the so-called "beer engines." It is stated that the old-fashioned method of drawing beer has one great disadvantage—the abstraction of the natural carbonic acid gas. In Keith's apparatus the beer is forced out of the barrels by compressed air supplied by a pump actuated by water pressure derived from the ordinary mains. By this means it is claimed the air simply acts as a weight, and is prevented from coming into direct contact with the beer by the layer of carbonic acid gas on the surface, CO_2 having a greater specific gravity than air.

The apparatus illustrated herewith is placed in a cellar or basement and connected to the ordinary service water pipe on the one hand and to the top of beer or other casks or closed vessels on the other hand. This compact little engine consists of three main parts, viz.: (1) The water cylinder, A; (2) the air pump, B; (3) the automatic governing valve, D. The water cylinder has a positive valve motion, is connected to the water main at H, and exhausts at K, the governing valve, D, being connected to the water pressure inlet. The air pump, B, is double acting and connected direct to the water cylinder, A, but owing to the open air space between them, it is impossible for any water to get into or near the air pump. The air pump valve box, C, is separate and can be detached by merely unscrewing one nut, each valve being accessible in a moment. The air delivery pipe, F, is preferably connected to the air receiver, which again supplies the air pipes leading into the top of the barrels or other closed vessels, or these can be directly supplied from the air pump, B, and the air receiver can be dispensed with. The governing valve, D, is operated by the air pressure and is exceedingly sensitive; when the pressure reaches the required point, it automatically shuts off the water from the cylinder, and so stops the motor. When the air pressure falls, however slightly, owing to liquid being drawn, the valve, D, instantly opens and the engine starts working until the pressure again reaches the normal. This controlling valve, D, is entirely new in principle and works most efficiently, and in quite a different manner from some forms of regulating valves, which generally require from one pound to three pounds variation of air pressure to move them. The working air pressure can be readily adjusted to suit circumstances by moving the sliding weight, G. The makers of this apparatus are the Water Motor and Automatic Liquid Elevator Company, Limited, Farringdon Street, London.—Engineer.

KEITH'S AUTOMATIC LIQUID ELEVATOR.

THE EARLY HISTORY OF CAST IRON PIPE.

AT one of the meetings of the New England Water Works Association, Mr. Jesse Garrett, of Philadelphia, dealt with the history of the manufacture of cast iron pipe, from which the Bulletin has culled the following:

Cast iron was known to Holland in the thirteenth century, and stoves were cast at Elass in 1400. But tradition has it, which an ancient Roman writer records, that the temple of the "Great Mother," at Sparta, is said to have been built by Theodorus, who first discovered the art of casting and making statues in iron. All this is necessarily vague, a condition which suggests a quotation from Dr. Greene, of the Boston Historical Society, in reference to the present disturbance of King's Chapel burying ground for the subway human conduit. "It is so full of bones and remains that I do not believe you could dig down to the depth of much more than an inch without turning up the dust of ancient worthies." The application is this, that in the dust of these "ancient worthies" it is impossible to verify the individual instance. As with the metal itself, so its discovery in the form of cast iron was an accident which occurred at one of the early iron works in the Rhine provinces, where a part of the "running" one day was found to be of different texture, and it was a problem for some time what to do with the strange stuff.

The first blast furnaces appeared in the Thuringian Mountains, which were almost identical in principle with the present furnaces, with the exception that hand or treadmill bellows were used for the blast, from which the present mechanical blowers are an evolution. In 1377 the first cast iron gun was cast in Erfurt, and the famous Krupp was casting guns in 1818, so that it appears iron was mostly used for destructive and not Samaritan purposes through many centuries of its history. In 1685 the first cast iron pipes were used for the water service of Versailles, followed by screwed and flanged pipes. In 1708 the Quaker, Darby, patented the system of box casting, and in the following year started the famous Coalbrookdale foundry, which, in 1780, turned out the first cast iron bridge. The first casting in the United States is said to have been made at Lynn, Mass., a cast iron pot, which was exhibited at the World's Fair at Chicago.

In the region of Alba Longa, buried by the volcanic eruption which drove the Albans to the present site of Rome, no trace of iron is found, and its absence is still notable in the archaic tombs of Rome. The metal for their implements, of whatever kind, was of bronze, and the early Roman religious sentiment shows such an abhorrence of iron as to make it a profane innovation to use it in almost any form, especially in and around their sacred temples. This superstition continued after the Christian era, even down to the fall of the empire. In their religious rites, if iron had in any way approached a temple or shrine, sacrifices were instituted to expatiate the profanation, so that we can hardly wonder that their attention was not turned to it as a substitute for lead pipe. When iron tools came to be used for engraving, and were so employed on certain altar inscriptions, penitential sacrifices were afterward offered by slaying a cow or a sheep on the altar. Bronze plows were used long after the introduction of iron plows. The high priests of Rome would not shave or have the hair cut with iron instruments.

The first mention of iron pipes I find was in an elaborate system built at Marli, near Paris, and set to work in 1682, costing $1,500,000. The account says: "They drew the water by short suction pipes from the River Seine, and forced it through iron pipes up the hill. They climbed to a height of 533 feet by a series of reservoirs and pumps, but this system came to be known as a 'monument of ignorance,'" probably after cast iron established confidence as a pressure pipe. Agricola makes no mention of cast iron pipes, although he shows three-legged pots of cast iron. Ramelli, about the same period, describes a hand mill of a portable character, whose casing, he says, is made of iron, and its form and ornamentation are such that there is little doubt it was made of cast iron.

Peter Maurice, a German engineer, in 1582 erected, under the arches of London Bridge, 16 pumps, 7 inches in diameter and 30 inches stroke, driven by a water wheel, and these were of cast iron, flanged at their lower end, bolted to a valve chest.

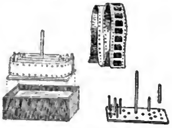
In 1835 it was estimated that over 1,000 miles of iron pipe were in use in the various systems of London water works, the first iron pipes having been laid 1746. Later on we find that cast iron pipes, 9 feet in length and 15 inches in diameter, with ball and socket flexible joints, were laid by James Watt across the Clyde for the conveyance of water to Glasgow, and another of the same size in 1818, and a little later on another of similar construction of 36 inches diameter.

Contemporary with the history of cast iron pipes in America is Peter Adams, a moulder and core maker, born in Millville, N. J., in the year 1823. His grandfather, James Adams, was a soldier in the revolutionary war. His father, Mark Adams, was born in 1788, and was a moulder and core maker at Weymouth, N. J., where he was engaged on the first cast iron pipes made for the city of Philadelphia, from designs and under the instruction and inspection of Frederic Graff, first, who was the then engineer of the Philadelphia water works, and father of the later Graff, who succeeded him in office. The first pipes made for Philadelphia were for the pumping main, of 18 inches diameter, delivering into the reservoir, the distribution still continuing throughout the city through wooden pipes. These pipes were cast direct from the melting of native bog ore, and the process was about as follows. In the beds where pigs were usually run were moulds for pipe, which tapped the flow from the furnace until one pipe was complete, then on to another mould, and so continuing for as many pipes as were planned for that pouring, using the surplus from the pipes for pigs as usual. The proprietor of these furnaces at Weymouth was a Mr. Richards, a native of the city of Philadelphia and its mayor at that time. After this, Mr. Adams thinks that the first pipe made at Millville, N. J., was about the year 1830, the inspector for which, under Mr. Graff, he remembers as one Louis Ort, who "was a good fellow enough, but inclined to be very particular unless he got one or two glasses of whisky before beginning his daily inspection, in which case it was very seldom that he would reject a good pipe."

The first pipes made at Millville, as at Weymouth, were from the product of the bog ore furnaces, and at that time, of course, cast upon their sides, a series of gates, six or eight in number, used for running the iron from the furnace into the pipe moulds, which, at the proper time, were cut off and the flow of iron continued to another series, or to the pigs, as the case might be. As time went on, and the demand for cast iron pipes increased, and sentiment ripened against using the melt direct from the ore, the proprietor of the Millville Works, David Wood, designed and constructed special foundries for their manufacture. The original proprietor of the Millville Iron Works, as before stated, was David Wood, a brother of R. D. Wood, who succeeded him and who afterward added to his pipe works from time to time until their production became the largest in the country.

DEVELOPER FOR FILMS.

ONE of the inconveniences of strips of films is that connected with development. It is either necessary to cut them in order to allow them to enter the tray, or else it requires great experience to cause them to pass through the bath properly. The small developer which we figure herewith solves the difficulty. It suffices to fix the strips around pegs, the emulsioned side outward,



DEVELOPING DEVICE FOR FILMS.

and to immerse the whole in the gutta percha trough containing the bath.—Le Monde Illustré.

PHOTOGRAPHIC WASTE MATERIAL AND WHAT TO DO WITH IT.*

IT would take but a sorry detective to discover the presence of an amateur photographer in any household his calling might lead him to be interested in. Every possessor of a camera is also the owner of vast treasure, in the way of glass, and his dwelling may be likened to a cross between a marine store and a crockery warehouse after it has been invaded by the proverbial member of the bovine species.

His friend looks in on Sunday evening and finds him piously engaged with a biblical treatise, a state of things which is sadly belied by scraps of P. O. P. scattered on the floor, and other telltale indications.

Undoubtedly spoiled negatives form the greatest part of the unsalable matter which litters his abode. I shall, therefore, consider these first. The uses to which a ruined negative may be put are manifold. Cut down to 3¼ inches square and the films cleaned off, they make excellent cover glasses for lantern slides. Another use for them in the same popular branch of photography is the following: If, during development, you see that your negative is spoiled through uneven density, excessive overexposure, or what not, expose it to the light and allow it to blacken all over. Now sealing-wax a needle to a penholder, and by means of this little tool you can easily manufacture diagram slides from your darkened film (white lines on black ground).

Take a spoiled negative, dissolve out all the silver with a solution of potassium ferridcyanide and hypo. Rinse, dry, rub with sandpaper, and you will have a splendid substitute for ground glass.

Remove the silver in a similar manner from another negative, but this time wash thoroughly. Squeegee down on this a print, and an opaline will be your reward. From such an opaline, by cementing on a few more glasses, a tasteful letterweight may soon be made. Another way in which very thin negatives may be utilized appeared in these columns some months ago. It is this: Bleach them in bichloride of mercury, back them with black paper, and positives will result. Old negatives also make good trimming boards, the film preventing a rapid blunting of the knife, and they may be successfully used as mounting tables. Clean off the films, polish with French chalk, and squeegee your prints thereto. When dry they may be removed and will have a fine enameled, if hardly artistic, appearance. Many other uses for them may also be found if the amateur is at all ingenious.

Users of pyro, instead of throwing the old developer away, should keep some of it and allow it to oxidize. A thin negative, if immersed in this for a few minutes, will be stained a deep yellow all over, and its printing quality will be much improved.

Old hypo baths should be saved, and, when a sufficient quantity of silver is thought to be in solution, reduced to recover the metal.

Printing paper of any sort is another great source of waste, especially to the inexperienced photographer. Prints are too dark or not dark enough to successfully undergo the subsequent operations. Spoiled material of this kind, however, is not without its uses in photography. Those who swear by that unreliable combination, yclept the "combined bath," will find that scraps of P. O. P., or any silver paper, are necessary to start the toning action.

Spoiled matt surface P. O. P., bromide paper, or platinotype should be allowed to blacken all over. Here we have a dead black surface useful for many purposes. A leak in the bellows when out in the field; repair it temporarily by moistening a piece of matt P. O. P. and sticking it on; the gelatine will cause it to adhere. These papers may also be used to back plates, platinotypes, of course, requiring some adhesive mixture to make them stick.

In every photographer's possession there will be found a small percentage of stained prints. Instead of throwing these away, you may often turn them to good account in the following manner: Take a large piece of cardboard, some mountant and the prints. Now proceed to tastefully mount them so that the corners of some overlap, arranging in every case to hide the stain. If you have gone properly to work, you will have an artistic mosaic. Now wash round with Indian ink, or paint a border of leaves, and the whole thing will form a very nice birthday gift to a friend. Little "tit bits" trimmed from a stained print are also very useful to mount on correspondence or invitation cards.

Keep the stiff bits of cardboard between which your printing paper is packed. They are useful in many ways—from opaque cards in the dark slide to partitions between negatives in the storing boxes.

Plate boxes are useful to store negatives in. Before doing this, however, each negative should be incased in a paper envelope. Hundreds of these latter may be quickly manufactured; cut out the pattern and get a juvenile to paste them for you at so much a score.

In short, nearly every waste product has its uses, even the brown paper in which your camera was packed. This makes a good paste down tint for mounting platinotypes upon.

There are, I know, a few amateurs with whom money is a plentiful commodity, and these can afford to be wasteful; but the great majority have to be careful with their cash, and to these economy means everything. Then there is the pleasure of knowing that you have obtained the maximum of success with the minimum of waste.

* By R. A. Hanolin, in the Photographic News.

CONVERTING SLUDGE INTO FUEL.

WORKMEN are now engaged at Rotherhithe in erecting machinery which, when in proper running order, is expected to revolutionize the methods of disposing of the more than two million tons of sludge that the main drainage committee of the County Council have to dispose of anually, says the Pall Mall Gazette. Before three months have passed, the municipal authorities of most of the large towns in the United Kingdom, together with the experts on matters connected with sanitation, are to be invited to witness the "trial trip" of the machinery, and if the results of experiments already made on a comparatively small scale are borne out in the greater experiment that is to be made, it is said that one of the greatest difficulties with which the authorities of most cities have to contend will disappear. Instead of a costly work, which it undoubtedly is at present, the doing away with the sludge will be converted into a profitable undertaking for the County Council.

Some years ago it was believed that the sludge of London possessed great value as a fertilizer, but those whose business it was to attend to its disposal found it quite impossible to get it taken up in sufficient quantities to be of any use to the County Council; and despite the enormous cost for steamers and their maintenance, it was found that to take it out and dump it into the North Sea fifty miles from shore was in the end the least expensive and most expeditious method of getting rid of the refuse.

The London County Council maintains a fleet of six sludge vessels, each capable of carrying a load of close upon one thousand tons to sea. The total number of trips made by these steamers last year was 2,176, and the cost of working the vessels came to more than £27,473. They are insured for £120,000, at an annual premium of £2,400. These expenses the new arrangement is expected to save, and at the same time the belief is that the County Council will be left in possession of an amount of fuel estimated at anything up to 700,000 tons per annum.

Leaving beaten tracks, investigators have for some time past been experimenting to convert the sludge into fuel, and the results obtained with comparatively moderate quantities, it is said, have led those interested to believe that all of the millions of tons annually dumped into the sea can be made, at virtually no cost, into good burning furnace fuel. When these experiments were completed those interested gave orders for the setting up of a large plant in Rotherhithe, and the work is now rapidly approaching completion. At the public trial of this machinery some half a hundred tons of the sludge brought from Barking is to be converted into fuel blocks by what is called the "Henry" process of sludge treatment. This process, briefly described, is as follows: The sludge, which, taken in large quantities, contains about 90 per cent. of moisture, would be treated by Hencke-Cunliffe machinery. It is pumped straight into machinery consisting first of two enormous hollow cylinders. These cylinders are heated internally by hot air, and being close-geared and revolving slowly, they are said to film the sludge on their face at about the thickness of a sheet of blotting paper. By far the greater part of the moisture is evaporated at one revolution of the big cylinders, and the nearly dried sludge is automatically scraped off, and falls into jacketed pans, which, like the cylinders, are heated by hot air and fitted with slowly revolving sweeps that stir and carry the sludge along until the whole of the acquired amount of moisture is evaporated. Then the sludge is automatically discharged upon machinery that presses it into fuel blocks ready for consumption in furnaces.

LEFTOMANIA.

ABSENT-MINDEDNESS would seem to be on the increase, says the Humanitarian. This is a disease not, indeed, to be found described in the pages of the British Medical Journal, but one, nevertheless, clearly defined under our present social conditions. To some extent kleptomania, with which we are all conversant, is its complement. The Great Eastern Railway auction is a wholesale example of the extent of the disease. Two thousand umbrellas, half that number of walking sticks, 800 hats, bicycles, perambulators, and feather beds were unintentionally abandoned by their owners during the past twelve months. Leftomania is recognized at all theaters, and due provision is made for the failing.

ENGINEERING NOTES.

For some years past a solitary dining car has been running on the Rohil Khand and Kumaon Railway. The example has now been followed on another line, a dining car having been recently put on the Bombay-Calcutta limited mail.

The Paris correspondent of The Times gives particulars of the trial trip at Mantes of the electric locomotive devised by M. Heilmann. The train was composed of twelve carriages and a luggage van, and carried 250 persons, and weighed about 150 tons. The object of the trip was not to make a trial of speed, and the train journeyed at the rate of only 18 miles an hour. The experiment seems, however, to have been considered a great success, and testimony is borne to the ease and regularity of the movement of the train. Great things are hoped from this invention, no less than the conveying of a train weighing 300 tons at a speed of 62 miles an hour being looked forward to.

In the latest annual report of the Chief of the Bureau of Steam Engineering the following note occurs: "The improvement in machine tools in the last twenty years has been so great that private builders who are at all enterprising throw away old tools, although in good condition, to give room for the latest and best. One large firm, with what was considered one of the best plants in the country, recently broke up good tools valued at $40,000, because they were becoming antiquated, and expended $200,000 for new ones of the latest pattern to replace them." It is by keeping themselves entirely up to date that the Americans are able to produce machinery of all sorts at a greater rate and more economically than other nations. The last sentence, coming as it does from The Engineer, of London, is significant.

Various schemes have been proposed for the last quarter century for the use of the ruins of the Cour des Comptes, on the Quai d'Orsay, in Paris, so long a memorial of the "Commune," and at one time it was arranged to convert the ruins into an imitation of the South Kensington Museum. But utilitarianism has finally gained the prize from decorative art. The Chamber has agreed, says Architecture and Building, to a proposition for the concession of the block to the Compagnie d'Orleans, in order to erect on the site a terminus which will be more central than the present building on the Boulevard Montparnasse. The interests of the International Exhibition of 1900 must have had an effect on the voting, for some years ago a railway terminus in such a position would not have been tolerated.

J. J. Holtzapffel, in a paper recently read before the Society of Arts on the uses of the sand blast, alluded especially to the value of the process in sharpening files and the superiority of the process, the sand-blasted file doing twice the work of the ordinary file in the same time, this superiority being now so fully recognized that 240,000 dozen files are so prepared in Sheffield yearly. They can also when worn be resharpened over and over again, without grinding out the old marks, for about 2½ per cent. of their value. He also spoke of the efficacy of the blast in removing every trace of scale from iron castings, so that the finest tools may be applied at once to the metal, and of its usefulness in refacing grindstones and emery wheels, cleansing bicycle tube surfaces before brazing, granulating or frosting electric plate, gilding metals, gold and silversmith's work, and jewelry, and many other purposes suggestive of a widely extended field for the sand blast in metallurgy.

Some interesting statistics of the world's output of steel were laid before the last annual meeting of the German Iron and Steel Institute, from which it appears that the production of steel ingots during the past three years was as follows:

	1894.	1895.	1896.
United States.	4,420,000	6,143,000	5,000,000
Germany	3,781,000	4,100,000	4,900,000
United Kingdom. ...	3,060,000	3,312,000	4,200,000
France	818,000	876,000	1,128,000
Russia	605,000	785,000	900,000
Austria-Hungary ...	649,000	782,000	862,000
Belgium	445,000	455,000	598,000
Sweden	167,000	194,000	250,000
Spain	70,000	65,000	105,000
Italy	65,000	80,000	60,000
Canada	40,000	40,000	40,000
Totals	14,274,000	16,738,000	18,650,000

In addition to the above, about 230,000 tons of crucible steel are manufactured, the United Kingdom producing about 100,000 tons, the United States about 70,000 tons, and other countries the balance, says The Colliery Guardian.

Some of the engineering difficulties encountered by those engaged in the construction of railways in Africa are pointed out by a correspondent of The London News, the principal one being the lack of water. Thus, at Wadi Halfa, the engineers' headquarters in the Soudan, some 12,000 gallons are daily collected and thence sent forth to the various stations, the most distant being 60 or 70 miles. The water is carried in iron tanks, each tank filling a truck. Every train that starts from Halfa laden with materials, such as rails, sleepers and other gear, has no less than fifteen of these trucks, which, by the exigencies of the situation, are loaded with water alone. The quantity of water thus conveyed, large though it is, suffices only for drinking purposes. On this account it has been considered a matter of great good fortune that the officers in charge of this work have now discovered that by boring at a point in the desert some 75 miles or so out from Halfa water may be obtained at a depth of about 50 ft. As might be expected, much speculation has been aroused by this flow of water more than 1,000 ft. above the level of the Nile. Among the many theories on this subject, that which obtains most favor among geological and other experts is this, namely, the existence under the Nubian desert, beneath a flooring of rock of varying thickness, of an immense reservoir containing a practically unlimited supply, and that digging at any one point would be rewarded with success, the question being merely one of depth. Another attempt is to be made to find water 50 miles further on.

ELECTRICAL NOTES.

It may not be generally known that in the city of Brussels, in Belgium, a system of electrically operated clocks was installed in April, 1857, at which time 100 clocks were installed, using the Nolet system. With some modifications, says The Electrical World, they have been in operation ever since then.

An exchange reports that in an examination that was made of some "electric belts" sold by a street fakir, it was found that beneath a strip of gauze was a layer of dry mustard. When the wearer perspired a little, the mustard was moistened and set up a burning sensation, and the deluded victim believed a current of electricity was passing through him.

An isolated electric plant was recently installed in a large tea firing or curing establishment in Yokohama. This establishment employs 2,000 people, who clean and sort the tea by native fan blowing and sifting machinery, after which it is taken to the firing rooms, containing 1,500 pots, set in brickwork and heated by a slow fire, the tea being stirred continuously by the coolie who attends each pot, the work going on day and night during the busy season.

United States Consul Child, at Hankow, has informed the State Department that an electric light plant has been established in that city, which is the capital of the most exclusive and hostile province in China. It was in this province that the Chinese a few years since refused to allow telegraph poles to be erected, and the missionaries have encountered there more opposition than at any other place in China. The public buildings have adopted the new light, and all prejudice is giving way to the new invention.

One of the many remarkable things in Australia is the overland telegraph from Port Darwin to the south of the continent, which was completed in 1872, says The Electrical Review. Almost the whole 2,000 miles of its length were through uninhabited country—much of it a waterless desert. The wooden poles were prepared at the nearest available places, but some had to be carried 350 miles, while the iron poles were taken an average distance of 400 miles by land. Over 2,000 tons of material had to be carried into the interior, and the total cost was $1,850,000.

A charter was granted by the State Department of Pennsylvania on November 8 to the Washington, Westminster & Gettysburg Electric Railway Company, which will build a line fourteen miles long, from Gettysburg to the State line. This is the company which intends to build a line to the national capital. The capital stock is $100,000, and the officers are: President, James B. Colgrove, Washington; directors: Samuel S. Bushman, Charles A. Trastel, and Henry C. Little, Gettysburg; Henry A. Cady, Washington; Charles H. Duttera and John A. Shore, Littlestown.

The lighting plant of the new limited trains of the Lake Shore & Michigan Southern Railway consist of a 30 horse power compound Westinghouse engine, with a 7 by 7½ inch cylinder giving 400 revolutions with steam at 80 or 90 pounds. The engine is direct connected to an 18 kilowatt Westinghouse compound multipolar generator of 120 volts, operating in all about 300 lamps of from 12 to 20 candle power each. The outfit is placed at the forward end of the luggage car, steam being supplied from the locomotive by a system of pipes and flexible rubber couplings. The cars are connected by a flexible plug coupling, and a similar plug is arranged to supply current from the city circuits at stations where a change of engine is necessary.

Three-phase current transmitted from the water power plants of Sacramento and San Joaquin Rivers is being used to operate milling machinery in Fresno, Cal. In the case of the Sperry Flour Mill a 150 kilowatt General Electric synchronous motor, running at 600 revolutions per minute, is operating the various machines, says Engineering News. In another mill, which is the largest flour mill in the United States using electricity as a motive power, three General Electric three-phase induction motors of 75, 30 and 20 horse power are belted to the mills, cleaners, etc. These motors are provided with recording meters and are run only when the machines to which they are connected are needed, thus effecting a saving of about 15 per cent. in power.

According to The Pall Mall Gazette, the movement toward an introduction of automobile cabs and omnibuses has reached Berlin, and soon a number will be in full action there. Some of the leading men of the electric establishments, among others Mr. Rathenau, the director of the Berlin Electric Works; Mr. Borsig, head of the largest locomotive building establishment; and Colonel Budde, the chief of the railway department in the "Genaistal" of the Prussian army, have founded a company for motor cabs and omnibuses in the great towns of Germany, and they will begin their action at once in Berlin if the president of police does not put a veto in their way. The Berlin pavement, mostly macadam in the principal thoroughfares, is well fitted for motor cabs, and there is every hope of success for such a company.

Nearly every electric road has one or more cars that are slow. They may be of a comparatively primitive type, as far as the motors are concerned, but the trouble can usually be cured by rewinding the armatures and fields, or by a rearrangement of the controlling apparatus, says The Electrical World. The presence of a single slow car will make itself felt very quickly over the whole line upon which it runs; and the quicker such a car is sent to the shop and "speeded up," the better will it be for the interests of the company operating it. On one road it has been the custom to run such cars only when the traffic was heaviest, probably with the idea that as the cars could not travel fast at such times, the slow car would not cause much trouble. The reverse of this was found to be the case. The slow car was slow in getting up to speed after stops, and caused great delay by that action. These cars are now operated only at night, when the motormen are naturally inclined to wild running. The slowness of the car acts as a check in this direction. Thus some use is made of the slow cars, but in spite of this they are being put into the shop to have motors rewound as fast as possible.

MISCELLANEOUS NOTES.

France has 83,163 public schools, an increase of 223 within a year; 15,969 of them are under clerical control. The number of teachers is 151,563, the number of pupils 4,580,183.

The management of French state railways has obtained permission of the minister of railways for the construction and reconstruction of a number of railway passenger carriages in which all parts formerly manufactured of brass, copper and iron, with the exception of axles, wheels, bearings, springs, brake gear and couplings, shall be made of aluminum. The weight of a coach with these fittings is one and a half tons less than that of an old style of carriage, and as an ordinary train in France consists of twenty coaches, says Aluminum and Electrolysis, the weight of the train would be reduced by thirty tons, which would mean a considerable saving in working expenses.

The seat of the Japanese matting industry is the town of Sa'kai, about eight miles south of Osaka, and having a population of 4,800. According to a consular report, the rugs are made principally of jute. The number of people employed in the manufacture is about 9,600, mostly children, girls and boys between seven and sixteen years old. There are 2,400 looms in 800 houses, giving an average of three looms to each house, and each loom is attended by four persons. The warps of the rugs are of cotton, but the weft is thick jute yarn, and the filling thin jute yarn. The designs are mostly Turkish and imitated Persian. The price ranges from 4 to 6 cents per square foot, according to the quantity of material used. When the weavers are fully employed in filling orders, they can turn out 1,800 square yards daily. The yarn used in this manufacture is principally imported from Calcutta.

The lack of efficiency in the ordinary belts is due principally to the air cushions between the belt and pulley, causing slippage. In the pneumatic pulley this air is entirely eliminated by means of perforations all around the face of the pulley. These perforations are regularly placed in rows parallel to the axis, the perpendicular positions of the perforations of each row alternating with those of the next. The belt closely grips the face of the pulley and operates, therefore, without the loss attending pulleys permitting an air cushion between the belt and the face. The use of this pulley, it is claimed, enables the use of a smaller and looser belt, owing to the elimination of nearly all slip, which, with the ordinary pulley, is said to be equivalent to a loss of about 10 per cent. in power. A more uniform speed can be obtained between the driver and driving element, which is an important feature in high speed work. Less tension on the belt means less oil in the bearings, and smaller belts mean smaller first cost.

The use of salt water by the New York fire department is again being discussed by a commission made up of Fire Commissioner Sheffield, Chief Bonner and Foster Crowell, M. Am. Soc. C. E., says Engineering News. Boston already has pipes laid for bringing in sea water for use in extinguishing fires, and Buffalo, Cleveland, Detroit and Milwaukee can use water directly from the lakes in similar cases of emergency. The plan is approved by the insurance companies of New York, and one prominent insurance officer says that a reduction of 5 per cent. in insurance rates would be possible on a line of 10 in. pipes connecting with the North River, or within 500 ft. of a fire unit connected with these pipes. Such a pipe system would vastly extend the usefulness of fireboats by making them effective at long distances from the shore line. The saving in water and damage by fire would more than offset the first cost. As showing the value of the property to be protected, the statement is made that the aggregate value of buildings and property between Chambers Street and Fourteenth Street is at least $500,000,000.

The Boston Transcript says: "Comparisons between the fire in London recently and the conflagration that swept the city in 1666 are natural at first glance, but in reality there is not the slightest resemblance between the two. The recent fire was diminutive in its proportions as compared with what will always be known in history as 'the great fire of London.' The conflagration which began September 2, 1666, and raged for four days, swept over 436 acres, destroyed fully 100 churches and public buildings and 13,200 dwellings. It rendered 200,000 people homeless. A considerable section of the city burned over was practically a survival of medieval London, of dark and narrow lanes and houses that simply stood because they had got into 'the habit of living.' The conflagration was, in fact, a purification by fire. The recent fire was confined to a few acres in the business center of London. The property loss, taking into consideration the scarcity of money two centuries ago, was not as large in the late fire as in 1666, nor are any considerable number of people rendered homeless. The buildings destroyed were business blocks. While some of these structures had been built or modernized within the last fifteen years, more of the blocks resembled the older style of business buildings wiped out by our own fire of 1872, with the addition of a frowsy dinginess of aspect due to the foggy and grime-spreading atmosphere of London."

An account of the organization of beet sugar factories in Germany, in the Consular Reports for November, is interesting as giving an example of the successful application of the co-operative principle. Out of the 399 factories now in operation, nearly half are stock companies, in which the majority of the shareholders are beet growers. These include not only most of the largest factories, but also the most prosperous.—An abstract of the Mexican Annual Statistician for 1895, just published, shows the population of the republic to be 12,578,861, and the surplus revenue nearly two million dollars (silver). There are 24 museums, 69 libraries, with 512,329 volumes; 30 scientific societies, and 454 periodical publications, including 41 dailies and 185 weeklies.—From an interesting description of a visit to the great salt wells in the province of Sze-Chuen, in Central China, we learn that the majority of the wells are from two to three thousand feet deep, and that the brine is evaporated by means of jets of natural gas. At one place the brine is carried five miles by a veritable pipe line (bamboo conduits) to the boilers. The wells are said to have been in operation two thousand years.

PICTURES OF SOUTHWEST AFRICA.

WINDHOEK, the capital of German Southwest Africa, is several hundred miles from the coast, and now can be reached only by a fatiguing journey of several weeks in heavy oxcarts, but next year a harbor is to be built at the mouth of the Swakop River, and then the railroad will be continued from there in the direction of Windhoek; the governor-general of the protectorate, Major Leutwein, has lately visited Germany on business connected with this project. The location of the place is delightful; the plateau on which Windhoek stands is bordered on the south by the Awas Mountains and there are heights on the north and east, and the atmosphere of the dry steppes is so clear that all characteristic features of the landscape stand out sharply like silhouettes. It is exposed not only to storms of the elements, but also of the different tribes; lying as it does between the land of the Hereros and the land of the Hottentots, it was always an "apple of discord" until Jan Jonker, a chief of the Orlamhottentots, laid a firm hand on it. In 1890, however, he was murdered by the tribe of Henric Witboy and the place was left free, but being of strategic importance, it was occupied by the Germans and made the capital of their colony. Their choice of a location was facilitated by the presence of several hot springs that could be utilized for the irrigation of gardens, if, as was to be expected, colonists should settle in the neighborhood. This expectation was soon realized, for at Klein Windhoek—so named for the sake of distinguishing it from Gross Windhoek, from which it is only half an hour distant—huts of industrious German pioneers rose about the half-ruined buildings of the Rheinische Missionsgesellschaft which once had possession of the place. Many have succeeded in wresting a livelihood from this wild and not very fertile land, but others have had to give up the hard struggle, for all are not fitted to bear the hardships that must be endured by colonists in a new country.

But to return to Windhoek: the fort, a solid structure of broken stone and brick, makes quite an imposing impression. It has a court 168 ft. long and 65 ft. 7 in. broad, surrounded by a high wall along the inside of which are arranged the rooms for the garrison. This outer wall is 19 ft. 8 in. high in some places. The fort is strongest at the four corners, which are provided with battlemented towers that could still offer a strong resistance, even if the court were taken by a hostile party, which is extremely unlikely to occur. North of the fort is a long row of buildings placed close together. These include stables, workshops, the prison, guardrooms, police station, officers' dwelling, the messroom and the house of the governor-general's secretary. A little below these lies the house of Major Leutwein, with its stables and pretty garden, and about 300 ft. farther down the mountain side are the government buildings and dwellings of several officials. It will soon be necessary to add to the number of business houses now possessed by Windhoek, as the town has gained considerable commercial importance. The natives, Hill Damaras, with some Hottentots and half breeds, live in square structures with walls of mud covered with clay and roofs made of reeds.

STATION HOUSE AT GROSS BARMEN.

COMPANY OF TROOPS OF THE PROTECTORATE (WITH LIEUT. EGGERS) IN FRONT OF THE FORT AT WINDHOEK.

A strong station house has lately been built at the village of Otjikango or Gross Barmen, which lies on the great highway that runs from the mouth of the Swakop River through Otjimbingwe to Windhoek. As early as 1844 a way station was founded here, near which are a number of hot sulphur springs, which seem to be specially efficacious in the treatment of skin diseases. A special charm is given to the spot by a little group of date palms that were raised from the seed by the first missionaries. These palms seem to thrive well, although their fruit ripens only in most favorable years, and even then its aroma cannot be compared with that of the fruit cultivated in North Africa. Otjikango is of historical importance on account of the numerous battles that have been fought, even recently, in the place itself and in the immediate neighborhood between Hottentots and the Hereros. The inhabitants of Gross Barmen belong to the Ovambandjerus tribe, and they wandered down from the north at the same time as the Hereros, with which race they have become blended.

The Hereros are the most powerful tribe in the protectorate and are looked upon as the conservative element that must be gradually trained and made useful for the common good. They are a fine race of men, with many excellent qualities, but, on the whole, their character is the same as that of the South African Kaffir. New arrivals often consider the Herero a stupid savage, but they soon learn from experience that he is, in his own way, a very shrewd fellow, and what seems like stupidity is only a certain slowness with which he follows the European's line of thought. The Hereros are cattle-raising nomads occupying the central part of the protectorate. Cattle, in fact, constitute their chief possession; they are devoted to them and in caring for them will even work—something they never do willingly. Milk is their chief food. A real Herero is very loath to sell his cattle, and never will part with any but the least valuable animals; he, like the Matabele, prefers to let his dearly beloved cattle die of old age, rather than let them go. Lately the rinderpest has made sad havoc among these cattle, of which some Hereros own many thousands, so that they are very rich, and it is impossible to say where the devastation will end. Christianity found a foothold among these people long ago, but comparatively few have been converted to this faith, because the Hereros are strongly attached to their own peculiar manners and customs. The dress of the Herero woman, who is not uncomely

HENRIC WITBOY AND HIS FAMILY.

CHIEF NICODEMUS AND SEVERAL OFFICERS

in her youth, is most original. On each leg she wears an ornament which consists of several strings of iron beads, twenty or more, according to the wealth of the wearer, and she wears an apron and a sort of bodice or corset composed of strips of leather on which little disks made of ostrich egg shells or balls made from a sweet-smelling root are sewed, and over her shoulders hangs a mantle that is fastened in front. Chains of iron beads are wound around her neck and the upper parts of her arms, while cuffs consisting of coils of strong iron wire cover her wrists. The queerest part of the costume is the headdress worn by married women, which is not unlike a bat's wing in shape. From the back of the top part of the headdress hangs a broad decoration consisting of strings of leather on which are strung little iron tubes or long beads, and these strings are held together by cross strings; this decoration hangs to the knees. The weight of jewelry carried around by a wealthy Herero woman may easily be estimated to weigh fifty pounds. She is not without a certain charm as she walks along with her mantle thrown coquettishly over her bare shoulders, the stiff corset holding her well shaped body straight and preventing any violent movement. She is the picture of natural strength and proud self-consciousness moulded to a native fashion.

Another rather wildly clad race in South Africa are the Bushmen, who still occupy large districts in South Africa, broken up into small bands. They may have been the aborigines, but in Southwest Africa they now resemble the Hottentots so strongly as to be almost indistinguishable from them. They go almost entirely without clothing; an apron that sometimes resembles bathing trunks and sometimes hangs down loose constitutes the only article of wearing apparel for most of them, but the older and more prosperous men and women sometimes wear a mantlelike shoulder covering of leather or fur, the fur being worn next the body. They hunt with the primitive weapons like those formerly used by the Hottentots, the bow with poisoned arrows and the boomerang. The poison for the arrows is taken from the juice of the euphorbia, or from certain insects or snakes. They are a miserable race, and as they have no cattle, they live on what they get by hunting and on wild fruit, and when brought in opposition to the Hereros really have no rights.

The yellow Hottentots living in the south of the land present a strong contrast to the Hereros. As a tribe they are lazy, careless, fond of drink; the former "prophet," Henrie Witboy, is inseparably associated with their history. He wanted to renew the glory of his tribe, who were once the masters of the Hereros, and the latter found him an enemy that was not to be despised. Although he was overpowered many times, he always found new ways of getting on, until he finally came into conflict with the Germans. The authorities warned him many times to give up his warlike attitude and to acknowledge the German protectorate, but he paid no attention to them, even when offered the most favorable conditions, and in 1893 he planned an attack on Windhoek, which he was prevented from making only by the arrival of a reinforcement of German troops. The subsequent events are well known; it was not until 1894 that Witboy's force was compelled to capitulate in Naukluft. Witboy is unquestionably a remarkable, energetic man, exerting the greatest influence over his fellow tribesmen, and at the same time he is cunning to the highest degree. His countenance displays a certain sullen determination. Our engraving of him and his family is a reproduction of a picture taken at Gibeon, the home of his tribe, where he and the remainder of his people were taken as pensioners of the government. The women standing beside him are his daughters, and in front of him sits his son Samuel, with his wife and children. Last year, at the time of the insurrection of the Khaus Hottentots and the Ovambandjerus, Witboy rendered the troops valuable services.

The Khaus Hottentots, who had been placed on a reservation in the south of the protectorate, moved north and seized Gobabis. They were joined by discontented Ovambandjerus, under their chief Kahimema, who had already, in 1894, made an attack on Gibeon during the absence of Witboy. But the real leader of this expedition was Nicodemus, the son of the oldest sister of old Maharero, the great chief of the Hereros. When the old chief died the honor was conferred upon Samuel Maharero, who was friendly to the Germans, and Nicodemus withdrew in anger from Okahandja, to pitch his tents in the land of the Ovambandjerus. By an energetic action of the troops of the protectorate, assisted by Witboy and his tribe, the insurrection was quickly suppressed, after a bloody battle, and the culprits had to endure a severe punishment.—Illustrirte Zeitung.

HERERO MEN, WOMEN, AND CHILDREN IN GROSS BARMEN.

BUSHMEN.

HERERO PRISONERS WITH CHIEF KAHIMEMA, WHO WAS AFTERWARD SHOT.

THE LIPARI ISLANDS.

By E. O. HOVEY.

THE beautiful group of islands known as the Lipari or Æolian Islands lies within easy reach of Messina by way of Milazzo, but rarely does a tourist make his way thither, and most of the foreigners who do visit the islands are geologists who wish to study the volcanic phenomena which are so clearly shown there. Seven islands, Vulcano, Lipari, Salina, Filicuri, Alicuri, Panaria and Stromboli, together with ten islets and numerous crags, form the group. Of these Lipari is the largest and most populous and is best known to the outside world, because it is the source of the pumice stone of commerce. The mountains of this material form a very striking feature in any view of the island from the east or northeast. The scenery of the islands is varied and beautiful, the villages are quaint and picturesque, and the people interesting, but the object of the present communication is to give a brief notice of the geology of the islands and an account of the ascents of Stromboli made on October 27 and 28, 1897, by Prof. H. F. Reid, of Baltimore, and the writer, rather than to dwell upon scenery or political history.

All the islands appear to be purely volcanic in origin, and all except Stromboli rise as more or less distinct cones from a depth of about 1,000 meters below the level of the sea, the cones of Vulcano, Lipari and Salina overlapping one another so as to form a composite series. Stromboli's base may be said to be at the 1,500 meter depth, judging from the contour map of the Italian government as published in Cortese's geological description of the islands. Stromboli has been known as an active volcano throughout all human history of this region, and Vulcano was the site of the forge of Vulcan or Hephæstus in ancient mythology. According to the historian Orosius, the island of Vulcanello, which is connected with Vulcano by a narrow isthmus, was formed by a series of eruptions about B. C. 204, and according to the same authority and Pliny a violent eruption occurred in B. C. 126 which broke up the island of Panaria into the group of islets now located on its site and destroyed part of it. No other eruptions on the islands have been recorded up to 1886, when Gran Cratere on Vulcano burst into a violent eruption of cinders and ashes, destroying the sulphur works which were operated in the bottom of the crater by an enterprising firm of Englishmen, and spreading a mantle of volcanic debris over a large part of the island and far beyond it.

The islands show several typical examples of the formation of successive craters along a line of fracture or weakness in the earth's crust, the destruction of one side of one crater being a preliminary to the formation of the next eruption center. Standing on the summit of Gran Cratere one readily sees that there have been at least four great craters on Vulcano, advancing from south to north, while Vulcanello shows three small ones advancing from east to west.

The visit to Vulcano and Vulcanello is easily made by rowboat from Lipari, and should on no account be omitted from a trip to the Æolian Islands. Landing at the Porto di Levante, one comes first upon the villa

of the proprietor and then upon some of the ruins of the sulphur and chemical works which were destroyed by the eruption of 1888. Everything has a most desolate appearance on account of the mantle of black ashes covering the ground. Some attempt has been made to cultivate the vine, but without much success, and the island is almost destitute of inhabitants, because since the eruption there has not been enough sulphur or sal ammoniac to make it worth while to rebuild the factory. The path up the cone leads one past several large fumaroles on the margin of the old crater ring surrounding the present crater. These fumaroles are surrounded by incrustations showing the characteristic lemon-yellow crystals of sulphur, and the fumes smell strongly of sulphureted hydrogen. The crater is nearly circular in form, rather more than a fourth of a mile in diameter, and two hundred feet or more in depth below the lowest point of the rim. The interior is a simple inverted cone, broken by two terraces on the west and north sides and having a ridge across the bottom which was thrown up by the last paroxysm of the eruption of 1888. The inner slope, though very steep, is not precipitous, except on the south and southwest sides, where the walls of the old crater rim are exposed. Slight fumarole action is observable in the very bottom of the crater and at several points high up on the walls. The great stream of obsidian on the north side of the cone, which is so prominent in Judd's description of Vulcano in his work on "Volcanoes," was covered to a great extent by lapilli and dust during the eruption of 1888.

To visit Stromboli, which lies twenty-two miles from Lipari, one must take a small boat with oars or sails for the journey one or both ways between the two islands, unless he is willing to spend a week on the island, for the steamer service is only weekly. San Vincenzo is the largest of the three hamlets on Stromboli and is the only one where the ordinary traveler can procure any tolerable entertainment. The village lies crowded together on the northeastern point of the island and is somewhat picturesque, like most Italian villages. A peculiar feature is the absence of four-footed beasts of burden. We did not see even a donkey during our stay on the island. Dogs and cats are scarce.

Instead of being a regular cone, as it seems to be from the sea, a glance at the map shows that the island of Stromboli is an irregular trapezium in shape, with its longest diameter from northeast to southwest. Its area is only about five square miles, two-thirds of which is under cultivation, almost entirely with the vine. Above the broad zone of grapevines comes a narrow belt of fig trees, above which is an irregular zone of tall coarse grass much used by the inhabitants in making fences for their vineyards. The upper limit of the grass is about 450 meters above sea level, as determined by Dr. Alfred Bergeat, of Munich, whose exhaustive treatise on Stromboli, published in 1896, should be read with care by those who wish detailed information about the island. A waste of black volcanic sand alternating with streams of lava turned red by weathering occupies the upper half of the altitude of the mountain.

Climbing to the northern summit, 918 meters above sea, one obtains a very clear idea of the volcano and its history. He sees around him extending from the northeast to the south and west the high lava walls of an old crater surrounding the present crater just as Monte Somma surrounds Vesuvius. This lava wall rises on the south to the elevation of 926 meters,* forming the culminating point of the island. Our point of observation is on the wall of an inner crater, and more than 200 meters below us on the north we can see the centers of activity forming the present series of small craters. To make this active crater, the northwestern quarter of the old crater wall was destroyed at a period antedating human history or tradition of the region.

The rim of the ancient crater consists for the most part of andesitic lava, and the steepness of the slope outside the crater on which this lava consolidated is surprising. I measured the inclination on the east side at between 31° and 32°, and the slope seems equally sharp all around. Cliffs giving partial cross sections of the cone show that flows of lava alternated with eruptions of ashes and coarse and fine lapilli in building it up. The lower parts of the old cone show that there have been periods of eruption of other and more basic lavas and the material thrown up in historic time is all basaltic in character.

As far as the writer is aware, all published accounts of Stromboli agree in assigning it constant activity. In ancient times the mountain was known as the "Lighthouse of the Mediterranean," and the beautiful rosy light reflected from the clouds of steam over the crater has often been described as one of the attractive features of a trip by water between Naples and Messina. The activity was such, however, that it could readily and safely be watched from a point near the crater, and the knowledge thus gained has contributed much to the science of vulcanology. Although molten lava could be seen in the bottom of the crater, according to several observers, when it was possible to look over the brink of the crater, all the descriptions speak of the activity as consisting merely of explosions recurring at more or less regular intervals, but the number of eruptive openings reported varied from one to seven. When Bergeat visited the mountain in October, 1894, there were four openings or craters extending in a northeast-southwest line, the largest and oldest crater being at the northeast. He watched the craters for five hours, keeping careful record of the time and character of each explosion from each opening, arriving at the conclusion that no rule could be laid down for either the frequency or the strength of the explosions. These explosions threw fragments of lava high into the air, most of which fell back into the crater from which they originated, but others fell outside to build up the cone or roll down the Sciarra del Fuoco into the sea. Such has been the usual state of things at Stromboli. No one has reported the volcano to be inactive, and only twice in the last hundred and twenty years (in 1881 and 1891) have lava streams been known to accompany an eruption.

In view, therefore, of the record of the volcano a statement of the present condition of affairs will not be without interest and some scientific value. When we visited the mountain there was no eruption in progress. The most southwesterly of the openings described by Bergeat seemed to have disappeared; the second and third were emitting copious clouds of vapor; the "old" crater was giving out but very little steam, though a great deal was coming from the top and outside of its eastern rim. The craters were wholly in the solfataric stage and had evidently been so for some time. Inquiry at Lipari elicited the information from Bartolo Nicotera, the guide to the islands, that there had been no eruption from Stromboli for about a year. An interesting phenomenon was the issuing of hot vapors from the top of the high ridge of tuff, cinders, etc., which rises 230 meters above the southern side of the new craters and is known as the "Cima dello Stromboli." Such vapors are not always rising from this high ridge when the volcano is active. The question as to whether Stromboli will ever resume its activity and again become the Lighthouse of the Mediterranean, as it was for so many centuries, is an interesting one, but one which it is useless to consider. Every other volcano has had its seasons of rest and of activity, and now even Stromboli, after centuries of ceaseless eruption, is having its period of quiet.

* This is the elevation given by the Italian naval chart. The French chart gives 918 meters, the English 3,090 feet (= 926 meters) and Bergeat determined it as 917 meters.

MENTAL EVOLUTION IN MAN.*

By R. M. BUCKE, M.D., Medical Superintendent of the Insane Asylum, London, Ontario, Canada.

ABOUT sixty years ago now, in the time of the Millerite excitement, a man who believed that the world was about to end expressed his fears to Emerson, who replied that it was really a matter of little consequence, "for," said he, "we can do very well without it." There are wise men who teach that each man creates the world he lives in, and as he gives it its substance so also does he give it its quality, insomuch that it is good or bad as he is good or bad. Be this as it may, it is certain that each one of us is of more consequence to himself than is all the outside world, be it shadowy or be it solid; be it created by each inhabitant or be it independent and self-existent. Not only so, but the essential part of each man is what we call his mind, in comparison to which the body is an insignificant factor.

The Study of Psychology.—This being granted, it would seem to follow that psychology ought to be the most interesting of all the sciences, and as a matter of fact it undoubtedly is so, though it has been greatly discredited by the imperfection of the method by which it has until very lately been studied. That imperfection is so great that it would hardly be an exaggeration to assert that nearly all the study and thought expended upon it down to the beginning of our own age has been fruitless and as good as wasted, except inasmuch as it has at last made clear the impassability of the route men have sought to follow, the route, namely, of introspection. For we might as well study the human body alone without reference to that of any other creature, and attempt in that way to decipher its genesis, development and meaning, as to attempt to comprehend a single human mind without including in our examination not only other human minds in all stages of evolution, but equally all other minds to which our own is related—that is to say, all minds other than human belonging to our kinsfolk the animals, minds which stand to-day like mileposts along the almost infinite length of the path which our mind has followed in its upward march across the immensities and eternities from its remote infancy to the present hour; minds which in a thousand faculties represent to us everywhere, in infinite sameness and variety, replicas of our own or of parts of our own, showing us, as the poet says, tokens of ourselves which we "negligently dropped as we passed that way huge times ago."

Comparative Psychology.—As man's bodily life rests upon and grows from that of countless prehuman ancestors; as man includes in his structure the heart of the reptile, the gills of the fish, as well as the forms in outline of innumerable still lower races, so is his so-called human mind rooted in the senses and instincts of all his ancestral species; and not only so, but these senses and instincts still live in him, making up, indeed, far the larger part of his current everyday life; while his higher psychical life is merely the outgrowth and flower of them.

As truly as the plant is an embodiment of inorganic matter vivified by the transmuted forces which in the non-vital world about us we call light and heat, so truly is man's mind the outcome of—the expansion and culmination of—the imperfect sensation of the worm, the rudimentary sight, hearing and taste of the fish and reptile; and the simple consciousness which, springing from these, passed to us after almost infinite ages of slow evolution and amelioration through tens of thousands of generations of placental mammals our immediate progenitors.

In the growth of mind, whether that of the race or of an individual, we recognize two distinct processes: First, the very gradual evolution to, or toward, perfection of faculties that have already come into existence; and, secondly, the springing into existence (as new branches start from a growing tree) of faculties which had previously no existence. For it is clear to the least thoughtful student that no faculty (as no organ) came into mature and perfect life at once. Hearing and sight, we are told, developed by slow degrees from the sense of touch; and in the region of the intellect conceptual life was born from ages of receptual, and that from millenniums of perceptual.

Mental Growth in the Individual and in the Race.—Let us now suppose mind growing for millions of years in the way set forth. It begins, we will say, as mere excitability; to that after a long time is added what may be called discrimination, or choice and rejection of, for instance, different kinds of food. After another long interval of almost infinitely slow advance sensation appears, and with it the capacity of pleasure and of pain; then, later still, memory; by and by recognition of offspring; and successively thereafter arise reason, recognition of individuals and communication of ideas. Concurrently with these intellectual faculties certain moral functions, such as fear, surprise, jealousy, anger, affection, play, sympathy, emulation, pride, resentment, grief, hate, revenge, shame, remorse and a sense of the ludicrous, have also arisen in the nascent mind. We have reached now the mental plane of the higher animals, which is equally that of the human being at about two years of age. Then occurs in the child the mental expansion which separates man from the higher mammals—for something like a year the child mind steadily grows from the status of the latter to the status of the human mind. This year in the individual, during which it walks erect, but possesses a receptual intelligence only, not having yet the power of forming either concepts or true words, represents in the race the age of the alalus homo, the period of perhaps a hundred thousand years, during which our ancestors walked erect, but, not having self consciousness, had no true language. At the average age of three years in the individual self consciousness is born, and the infant, from the point of view of psychology, has become a human being. But we all know that after the attainment of the distinctively human faculty, self consciousness, the child has still much to acquire, both in the way of the expansion of already possessed faculties and in the acquisition of new ones, before it is mentally a mature man. Of the numerous faculties which it still has to acquire I shall mention only here the color sense, the sense of fragrance, the human moral nature and the musical sense. A consideration of these four and of self consciousness will occupy the short time allotted me to-day.

And first a word as to that basic and master human faculty, self consciousness. It occurs, as said, at about the average age of three years, but when it first made its appearance in the race it must have done so at full maturity; perhaps at the age of twenty, both life and childhood being shorter at that time than they are to-day. You will see at once why I say self consciousness must have occurred at first at maturity. Its acquisition at a given epoch supposed a higher mental life than had hitherto existed—such higher life on the part of the race could not have come to the individual before his maturity. To suppose that it would be (if you will think of it) a contradiction in terms. The human mind attains its high water mark at maturity (that is what the word means), and one generation could not reach before maturity what the preceding generation had not reached at all. Well, but self consciousness occurs to-day at three years of age, and we reach full mental maturity (on the average) only at the age of thirty-five. The advance then made by the individual from the age of three to that of thirty-five represents the advance of the race between the date of the appearance of self consciousness and to-day, the mental status of the three-year-old child to-day being the mental status of the adult when self consciousness first appeared. How long has it taken the human mind to grow from mere self consciousness to its present stature? Not less certainly than several hundred thousand years. Whatever the time required, is the time during which man has inhabited the earth.

Of all the mental faculties below self consciousness each one has its own time for appearing in the human infant—as, for instance, memory and simple consciousness appear within a few days after birth, curiosity ten weeks after, use of tools twelve months after, shame, remorse and a sense of the ludicrous—all of them about fifteen months after birth. Now it is to be noted that in every instance the time of the appearance of a faculty in the infant corresponds with the stage at which the same faculty appears (as far as can be at present ascertained) in the ascending animal scale; for instance, memory and simple consciousness occur in animals as primitive as the echinodermata, while the use of tools is not met with below monkeys, and shame, remorse and a sense of the ludicrous are almost, if not entirely, confined (among animals) to the anthropoid ape and the dog.

To turn now to the true subject of this paper, I want to say in the first place that, as in prehuman, so in human psychology, each superadded faculty was acquired in its own time in the history of the race, and that that historic period corresponds with the time in the life of the individual into whom the faculty is born to-day. For instance, self consciousness appears in the individual at the age of about three years—it appeared in the race several hundred thousand years ago. It has been proved by Geiger and others that our color sense has been acquired by the race not more than about thirty thousand years ago. Well, it is acquired by the individual at the age of about five or six. It is thought that the sense of fragrance was acquired by the race later than the color sense; it is also acquired later by the individual. Some considerable study of history has led me to the conclusion that our human moral nature cannot be more than ten thousand years old. For a careful consideration of the records that have come down to us from the early Romans, Hellenes, Hebrews, Egyptians, Assyrians and Babylonians would indicate, I think unmistakably, that, as we go back into the past, this faculty tapers down toward the vanishing point, and that if it continues so to taper as we ascend the ages, all of what we distinctively call our human moral nature would certainly have disappeared by the time we had gone back the number of centuries mentioned—that is, ten thousand years.

Well, to-day the human moral nature in the individual, instead of being born at the age of three years, as is self consciousness, or at five or six, as is the color sense, does not come into existence before the average age of about fifteen years. As to the musical sense, it is almost certainly less than five thousand years old in the race, and, when it occurs at all, is not usually born in the individual before adolescence.

There are three other laws, each well worthy of notice, which govern the acquisition of new faculties by any given race. They are as follows:

1. The longer a race has been in possession of a given faculty, the more universal will that faculty be in the race. This proposition scarcely needs proof—every new faculty must occur, first of all, in one individual, and as other individuals attain to the status of that one they too will acquire it, until after perhaps many thousands of years, the whole race having attained to that status, the faculty shall become universal.

2. The longer a race has been in possession of a given faculty, the more firmly is that faculty fixed in each individual of the race who possesses it. In other words,

* An address delivered at the opening of the section of psychology, at the annual meeting of the British Medical Association at Montreal, September 1, 1897.

the more recent is any given faculty, the more easily is it lost. High authority, such as that of Charles Darwin, could be quoted in support of this proposition; but it scarcely seems to be required; it is almost, if not quite, a self evident proposition.

3. A study of dreaming seems to reveal the fact that in sleep such mind as we have differs from our waking mind, especially by being more primitive; that, in fact, it would be almost strictly true to say that in dreams we pass backward into a prehuman mental life; that the intellectual faculties which we possess in dreams are, especially, recepts as distinguished from our waking concepts; while in the moral realm they are those faculties such as remorse, shame, surprise, along with the older and more basic sense functions, which belonged to us before we reached the human plane; and that the more modern mental faculties, such as color sense, musical sense, self consciousness, the human moral nature, have no existence in this condition, or if any of them do occur, it is only as a rare exception.

Let us now compare, one with the other, a few of the faculties which have been already mentioned in the light of the rules laid down. To do this will give us, more clearly than perhaps anything else could, a definite notion of the growth of mind by the successive addition of new functions. For this purpose we will take simple consciousness, shame, self consciousness, color sense, the human moral nature, and the musical sense.

Simple Consciousness.—Simple consciousness makes its appearance in the human infant at the age of a few days; it is absolutely universal in the human race; it dates back certainly to the earliest mammals, and probably much earlier; it is lost only in deep sleep and coma; it is present in all dreams.

Shame.—Shame is said to be born in the human infant at the age of fifteen months; it is a prehuman faculty, being found in the dog and in apes, and undoubtedly existed in our prehuman ancestry; it is almost universal in the race, being absent only in the lowest idiots; it is very common in dreams.

Self Consciousness.—Self consciousness makes its appearance in the child at the average age of three years; it is not present in any species but the human; it is, in fact, that faculty the possession of which by an individual constitutes him a man. It is not universal in our race, being absent in all true idiots; that is, it is permanently absent in about one in each thousand human beings born into the world. In our ancestry it dates back to the first true man; a race, we are told, unclothed, walking erect, gregarious, without a true language, to a limited extent tool using, destitute of marriage, government, or of any institution, animal, but, in virtue of its highly developed receptual intelligence, king of animals, which developed self consciousness, and by that fact became man. It is impossible to say how long ago it was when this event occurred, but it could not have been less than several hundred thousand years. This faculty is lost much more easily and frequently than is simple consciousness. We lose it in coma and also often in the delirium of fever; in certain forms of insanity, as in mania, it is often lost for weeks, even months at a time; and lastly, it is never present in dreams.

Color Sense.—I have elsewhere written at large on the color sense, and have only space here to give the facts which bear on the present inquiry. That these are facts the argument referred to, I think, demonstrates. This faculty appears in the individual at the average age of about five years. It is absent in one adult human being out of every forty-seven; it appeared in our ancestors, as Geiger has shown from linguistic paleontology, in the Aryan period, probably less than thirty thousand years ago. It is seldom present in dreams, and when it does occur—that is, when any color is seen in a dream—it is generally that color which, for good reasons, was first perceived by man, namely, red.

The following occurrence illustrates (I think in a striking manner) the usual absence of the color sense during the partial consciousness which occurs in sleep. A man whose hair is white dreamed that he was looking in a glass and saw plainly that his hair was not only much thicker than he knew it to be in fact, but instead of being white, as he also knew it to be, it was black. Now, he well remembered in his dream that his hair had never been black. It had, in fact, been a light brown. He wondered (it is worth mentioning here that wonder or surprise is a prehuman faculty, and is common in dreams) in his dream that his hair should be black, remembering distinctly that it had never been so. (I may say here that memory is a prehuman faculty, and is common in dreams.) The important thing to note about the dream under consideration is that, though it was clear to the dreamer's mind that his hair had never been black, yet he did not remember that it had been brown. For some reason (and I think the reason is quite clear) there was a difficulty in calling up before consciousness any color.

Moral Nature.—The human moral nature belongs to a much later stage of evolution than any of the faculties so far considered. It does not make its appearance in the individual before the average age of fifteen years. It is congenitally and permanently absent in at least forty human beings out of every thousand. It would seem clear, as stated already, from a consideration of our historic ancestors, from the fact that this faculty rapidly fades out as we ascend into the past, that it cannot have existed in the race more than ten thousand years at the most. It is far more unstable in the individual than are older faculties, such as self consciousness. It is never present in dreams.

Musical Sense.—Finally, the musical sense (a faculty which is now in the act of being born into the race) does not appear in the individual before the average age of about twenty years. It does not exist in more than half the members of the race. It has existed less (perhaps considerably less) than five thousand years in the race. It is never, or almost never, present in dreams, even in the case of professional musicians.

The Scheme of Mental Evolution.—You see now clearly the scheme upon which I suppose the mind as far as we have got to have been built. I say advisedly "as far as we have got," because, if the mind has grown in the way set forth, it is still growing and is not built, but is in the act of building. No one can ever say positively that his theory (of any fact) is the true one, but I am prepared to say of the above hypothesis that, if it be accepted, it will enable us to understand something of the phenomena of mind as we observe it, whereas, if we should prefer to hold, as many do, that the human mind was created independently of any that preceded it by a fiat and per saltum, then I say deliberately that there is and can be no such thing as a science of psychology, and that every attempt to investigate or explain, to comprehend or divine the rationale of the facts observed as to its origin and growth in the individual must remain forever futile. And, if I could find the right words, I would bring home to each one who hears me the inextinguishable conviction that, in this idea of evolution, lie enfolded the mystery of the past, the explanation of the present, and the sure prescience of the future—what we were, what we are, and what we shall be.

The Atavistic Theory of Idiocy and Insanity.—In conclusion, I desire to refer briefly to two corollaries which flow from this hypothesis. The first is that if it is correct, then all forms of insanity, including all forms of idiocy, are nothing more nor less than cases of atavism. In this view insanity is due to congenital absence or imperfection (leading to breakdown) of some faculty or faculties, such absence or imperfection being due to more or less complete reversion to an ancestral type. In my opinion, this view explains insanity and its numerous forms more completely than these can be explained from any other point of view, and is, therefore, of great value to the thoughtful student of these phenomena. Upon this view the comparatively recent origin and rapid evolution of the human mind, and especially the rapid mental evolution of the so-called Aryan peoples in the last four or five thousand years, is almost solely responsible for the large number of cases of insanity in the modern civilized world, since the stability of any form, function, or faculty in any race is dependent upon the time it has existed in that race, and, therefore, the more recent a faculty is in a race the more frequently will it be found absent, defective or unstable in the individuals of the race.

Future Development of Mind.—The second corollary, which is even more important than the first, is that, upon the view here set forth, the human mind at present is not formed, but forming; is not completed, but in process of construction. By slow and dubious steps taken in darkness our remote ancestors wearily climbed to simple consciousness. After another immense interval they reached self consciousness. But that cannot be the end—the cosmic process cannot stop there—cannot, indeed, stop anywhere. Evolution, as far as we can see, has always gone on, is going on to-day, and will always go on. Our old mental faculties are some of them fading out, others advancing toward greater perfection, and alongside of them new ones are springing up, some of which will, without doubt, be of overshadowing importance in the future.

So-called telepathy and clairvoyance seem to be specimens of such nascent faculties. I place in the same class the phenomena of what is often named spiritualism. The labors of the Society for Psychical Research have made it to me plain that these phenomena, as notably in the case of W. Stainton Moses, really exist. And I think that a study of the above-mentioned case, together with that of Mrs. Piper and that of Mary J. Fancher, of Brooklyn, would compel any unprejudiced person to make the same admission. But to me these are not cases in which outside agents are acting on or through a human being, but are cases in which a given human being has faculties which are not commonly possessed. Whether any given faculty, such as one of those now alluded to, shall grow, become common, and finally universal in the race, or wither and disappear, will depend upon the general laws of natural selection, and upon whether the possession of the nascent faculty is advantageous or not to the individual and to the race.

But of infinitely more importance than telepathy and so-called spiritualism (no matter what explanation we give of these, or what their future is destined to be) is the final fact to be here touched upon. This is that superimposed upon self consciousness, as is that faculty upon simple consciousness, a third and higher form of consciousness is at present making its appearance in our race. This higher form of consciousness when it appears occurs, as it must, at the full maturity of the individual, at about the age of thirty-five, but almost always between the ages of thirty and forty. There have been occasional cases of it for the last two thousand years, and it is becoming more and more common. In fact, in all respects, as far as observed, it obeys the laws to which every nascent faculty is subject. Many more or less perfect examples of this new faculty exist in the world to-day, and it has been my privilege to know personally, and to have had the opportunity of studying, several men and women who have possessed it. In the course of a few more millenniums there should be born from the present human race a higher type of man possessing this higher consciousness. This new race, as it may well be called, would occupy, as toward us, a position such as that occupied by us toward the simple conscious alalus homo. The advent of this higher, better and happier race would amply justify the long agony of its birth through the countless ages of our past. And it is the first article of my belief, some of the grounds of which I have endeavored to lay before you, that a race is in course of evolution.

FURTHER EXPERIMENTS ON THE LIQUEFACTION OF FLUORINE.

By M. Moissan and J. Dewar.

In May, 1897 (Comptes Rendus, cxxiv, 1202), we had the honor of presenting to the Academy our first experiments on the liquefaction of fluorine; we will now describe some fresh experiments we have made on this subject.

Liquefaction of Fluorine.—Our latest experiments on liquefaction were carried out by means of an apparatus similar to that which we have already described, that is to say, a glass bulb fused to a platinum tube, which contained another similar smaller tube; but each of these tubes was fitted with a screw valve in such a manner that at any moment communication, either with the outer air or with the current of fluorine, could be interrupted. This little apparatus was placed in a cylindrical glass receptacle, with double sides, containing liquid air. The whole was connected with a vacuum pump and furnished with a manometer.

In a series of preliminary experiments we determined exactly the boiling points of liquid oxygen at various pressures, as shown by the manometer.

In some former experiments we had shown that fluorine does not become liquid at the temperature of boiling oxygen at the ordinary atmospheric pressure.

We now find that, by repeating the same experiment with freshly prepared liquid air, the fluorine becomes liquid as soon as the air begins to boil at the ordinary pressure.

We have repeated our former experiment, with liquid oxygen as refrigerant, and, on making a vacuum, we find that the liquefaction of fluorine takes place by the evaporation of the oxygen at a diminution of pressure of 32·5 cm. of mercury.

From these two experiments we are enabled to state that the boiling temperature of fluorine is very close to −187°.

Experiments on Solidification.—When the little glass bulb was three quarters full of liquid fluorine, we closed both the valves and then caused the liquid air serving as refrigerant to boil rapidly at a diminution of pressure of 72·5 cm. Under these conditions we obtained a temperature of −210°. The fluorine did not show any sign of solidification, but retained its characteristic mobility. To complete this experiment it becomes necessary to cause the rapid ebullition of the liquid fluorine thus obtained; we hope to achieve this in future experiments. When we had repeated this experiment several times, a slight accident occurred to one of our little instruments containing the fluorine. The screw of one of the valves becoming worn, allowed the air to enter the bulb. This air was immediately liquefied, and in a few moments we had two distinct layers of liquid; the upper, colorless layer consisted of liquid air; the lower one, of a pale yellow color, being fluorine.

In another experiment, taking great precautions to prevent the ingress of any air, the fluorine was introduced in its liquid state into a glass tube, the end of which was then sealed before the blowpipe. The sealed tube, containing the liquid fluorine, was kept for a long time at −210° by the rapid evaporation of a large quantity of liquid air, but it gave no trace of a solid body.

Density of Liquid Fluorine.—To determine the density of liquid fluorine, we brought it into contact with a number of bodies whose density is known exactly. By taking groups of bodies whose densities are very close to each other, it is easy to see which sink and which float in the liquid. This well known though indirect method was the most suitable for these delicate experiments. We first of all satisfied ourselves that the fluorine had no action on the materials used. To effect this we placed a crystal of sulphocyanide of ammonium (density = 1·31) in a glass tube surrounded with boiling liquid air; we then turned in to the bottom of the tube a current of fluorine gas by means of a platinum jet. The fluorine was rapidly liquefied, and the sulphocyanide of ammonium was not attacked. We repeated the experiment with a fragment of ebonite (D = 1·15), of caoutchouc (D = 0·99), of wood (D = 0·96), of amber (D = 1·14), and of oxalate of methyl (D = 1·15). It is of importance, in the experiments we have just mentioned, that the various materials used should be first kept at a temperature of −200° for some little time.

In one of our experiments a piece of caoutchouc, having been insufficiently cooled, took fire on the surface of the liquid and burnt completely away with a brilliant flame, without leaving any residue of carbon.*

The experiment was carried out in the following manner: In a glass tube closed at one end, and of which the lower part had been slightly drawn out, we placed fragments of the five substances we have just mentioned. The tube was then plunged to a third of its length into boiling liquid air. When it was all reduced to a temperature of about −200° we carefully introduced the fluorine gas. This soon became liquefied, and we saw the wood, the caoutchouc and the ebonite floating easily on the surface of the pale yellow liquid. On the other hand, the oxalate of methyl remained at the bottom, while the amber rose and fell in the liquid, appearing to be of the same density. The apparatus was shaken several times, and the quantity of liquid fluorine increased, but the results were always the same.

We, therefore, arrive at the conclusion from these experiments that the density of liquid fluorine is 1·14. Another point which appears to be of interest is the following: The fragment of amber floating in the fluorine was very difficult to distinguish, which would seem to indicate that the index of refraction of liquid fluorine is very close to that of solid bodies.

In another experiment we liquefied fluorine in a glass tube which had been previously graduated; we then sealed the tube, which had been weighed before the experiment, and left it alone in a beaker full of liquid air at the ordinary pressure. An hour and a half afterward, the tube still being in 1 cm. of liquid air, the fluorine had not changed in appearance. But shortly afterward, when the air had all evaporated, a violent detonation occurred; the sealed tube and the double beaker in which it had been placed were smashed and reduced to powder. The sealed tube showed us that liquid fluorine sustains at from −187° to −210° a diminution of volume of $\frac{1}{11}$.

Absorption Spectrum.—We examined with the spectroscope different samples of liquid fluorine through a thickness of about 1 cm., either in sealed tubes or by means of our little condensing apparatus, but we have never been able to detect absorption bands.

Magnetism.—Liquid fluorine placed between the poles of a powerful electromagnet does not show any magnetic phenomena. These experiments are the more decisive, as we made comparative ones with liquid oxygen, as before; they were repeated several times.

Capillarity.—The capillary constant of fluorine is weaker than that of liquid oxygen. A capillary tube

* This piece of caoutchouc ran about the surface of the liquid like sodium on water, giving a very intense light.

plunged successively in fluorine, oxygen, alcohol and water gave the following figures:

Height of liquid fluorine	3·5	mm.
" " oxygen	5·0	"
" alcohol	14·0	"
" water	22·0	"

THE ACTION OF SOME SUBSTANCES ON LIQUID FLUORINE.

Hydrogen.—Liquid fluorine in a glass tube was cooled down by liquid air boiling at a low pressure. A slow current of hydrogen gas was made to impinge on the surface of the yellow liquid by means of a platinum jet. There was immediate combination, with the production of a flame which lighted up the tube. The experiment was repeated by dipping the platinum jet below the surface of the liquid. At this temperature (−210°) complete combination still took place, with a considerable evolution of light and heat.

In another experiment the hydrogen apparatus terminated with a fine glass tube dipping into the liquid fluorine; when the hydrogen was turned on, the combination took place immediately and with violence.

Oil of Turpentine.—Oil of turpentine, frozen and cooled down to −210°, is attacked by liquid fluorine. To perform this experiment we placed a little oil of turpentine at the bottom of a glass tube surrounded with boiling liquid air. As soon as a small quantity of fluorine was liquefied on the surface of the carbide the combination took place with explosive force, a brilliant flash of light and deposition of carbon. After each explosion the current of fluorine gas was kept up slowly, a fresh quantity of liquid fluorine was formed and the detonations succeeded each other at intervals of from six to seven minutes. Finally, after a longer interval of about one minutes, the quantity of fluorine formed was sufficient to cause at the moment of the reaction the complete destruction of the apparatus.*

Oxygen.—The action of liquid oxygen has been studied with much more care, since we observed from our earliest experiments that by passing a current of fluorine through liquid oxygen we obtained a detonating body.

If we bring a current of fluorine on to the surface of liquid oxygen in a glass tube, the fluorine dissolves in all proportions, imparting a yellowish color, and giving the liquid a graded tint from the upper to the lower part; the bottom of the tube is hardly colored. If, on the contrary, we introduce the fluorine gas at the bottom of the liquid oxygen, the yellow color is produced at the bottom and diffuses slowly to the upper layers.

This phenomenon indicates that the densities of liquid fluorine and oxygen are very near each other. When we have obtained a mixture of liquid oxygen and fluorine, if we allow the temperature to rise slowly, the oxygen evaporates first. The liquid becomes more and more concentrated as to fluorine, and finally the latter begins to boil in its turn. In fact, at the commencement of this boiling the gas coming off will light a match which has only a red hot point, and will not make lampblack or silicon red hot; but, on the other hand, the gas coming off at the end of the experiment will instantly cause these two latter bodies to burst into flame. When the glass bulb is completely empty and its temperature is rising, we suddenly notice a distinct disengagement of heat, and the interior of the glass loses its polish. This rise of temperature is due to the fluorine gas attacking the glass. In this experiment, when using perfectly dry oxygen, no precipitate is produced. If, on the contrary, we use oxygen which has been some hours in contact with the air, the detonating substance we mentioned in our previous communication is produced with great readiness.

In one of our experiments, in which we tried to obtain a suitable quantity of this body, we had an explosion strong enough to smash the glass in which the experiment was being performed.

To sum up, this body, which is produced by the action of fluorine on moist oxygen, seems to be hydrate of fluorine, decomposing, with detonation, by a simple rise of temperature.

Water.—We froze and cooled down to −210° a small quantity of water at the bottom of a glass tube. Liquid fluorine formed on the surface of the ice as a mobile liquid without action, and it evaporated on the temperature rising. As soon as the apparatus became warmer the remaining gaseous fluorine attacked the ice with great energy, and we noticed a strong smell of ozone.

Mercury.—We solidified a globule of mercury at the bottom of a tube. The surface remaining very brilliant, the liquid fluorine surrounded it without causing it to lose its appearance or polish. On allowing the temperature to rise to −187°, the fluorine began to boil, the liquid disappeared completely, but the attack of the mercury by the fluorine gas did not take place until the apparatus had almost reached the temperature of the laboratory.

CONCLUSIONS.

Fluorine gas is easily liquefied at the temperature of boiling atmospheric air. The boiling point of liquid fluorine is −187°. It is soluble in all proportions in liquid oxygen and in liquid air. It does not solidify at −210°. Its density is 1·14, its capillarity is less than that of liquid oxygen; it has no absorption spectrum and it is not magnetic.

Finally, at −210° it has no action on dry oxygen, water or mercury, but it reacts, with incandescence, on hydrogen and oil of turpentine.—Comptes Rendus, cxxv, No. 15, p. 505, 1897.

In his monthly report to the Chief of Engineers Col. T. W. Bingham, Commissioner of Public Buildings and Grounds, says that 10,801 persons went to the top of the Washington Monument during October, and 3,317 of them walked. Since October 9, 1888, when the monument was opened to the public, 1,453,555 persons have gone to the top.

Olive growing on the Italian Riviera is giving way to the cultivation of flowers, chiefly roses and pinks, for the London and Paris markets.

* In several of our experiments we accidentally let a little liquid fluorine fall on the floor; the wood instantly took fire.

ROLLER BOATS.

The Bazin roller boat is slowly proceeding with experiments that up to the present have not completely responded to the hopes of its inventors. It is very certain that in the preparatory studies certain factors were neglected that intervened in large proportions to diminish the speed that it was expected to obtain. Thus, in an experiment made upon the Seine, in an unobstructed course, the speed did not exceed eight or nine knots with the propelling and rotary engines developing their full power. According to calculations, from eighteen to twenty knots ought to have been obtained. The two resistant forces that have the most action are adhesion and the friction of the water against the rollers.

Fig. 1 represents one of the rollers supposed to be moving at a velocity of from ten to twelve revolutions at the fixed point. The water is carried along to the upper part, not only upon the external circumference, but also upon a large part of the spherical cap. There is thus produced a great resistance which it will never be possible to get rid of, even as has been proposed, by covering the wheels with a coat of varnish or with a fatty substance.

The second cause of resistance is due to the friction of the water against the four rollers, the submerged surface of which is quite wide. It has often been said that in the Bazin roller boat rolling friction is substituted for sliding. This is true only in part, since, in consequence of the speed of the boat and of the revolution of the rollers, there is developed upon the submerged portion of the latter a force of sliding friction that there is reason for taking into account in the appreciation of the results.

There is another drawback that this type of vessel will always present, and in regard to this all mariners are unanimous, and that is the difficulty, not to say impossibility, that will be found of remaining at sea in foul weather.

One must never have seen the water of the ocean during a squall of wind, and consequently be ignorant of the power and violence of the waves, to believe that such a vessel is capable of resisting them. It would, as sailors say, be swallowed by the sea, even were it capable of supporting the stresses that huge waves, breaking under the foot bridges, would exert upon the latter and cause the whole thing to capsize.

Fig. 2, which represents the stern of the roller boat, plainly shows to what dangers the four faces of such a vessel are exposed.

Fig. 1.—STERN LARBOARD ROLLER.

It may be added that, were the Bazin roller boat to make the high speeds predicted by its inventors, it might be utilized upon lakes and large rivers for the carriage of passengers, since there is not enough space upon it to permit of doing a large freight business.

The idea of constructing a boat to roll upon the sea is not new. The Call, a San Francisco newspaper, in its issue of November 20, 1895, devoted an article entitled "To Roll upon the Water" to the description of a vessel that was to rival the fastest trains in speed (Fig. 5). Mr. Chapman describes his invention as follows:

Fig. 2.—VIEW OF THE STERN OF THE BAZIN ROLLER BOAT.

Between two huge cylinders are suspended the hull, the deck and the cabins for freight and passengers. Along each side are the foot bridges that connect the axes of the two cylinders. Upon these axes, which are fixed, revolve, in ball bearings, the bases of the two cylinders and, consequently, the cylinders themselves.

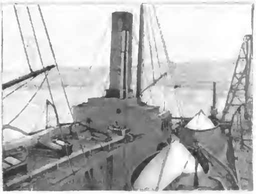


Fig. 3.—STERN LARBOARD AS SEEN FROM THE FOOTBRIDGE.

In order to obtain the motive power necessary for the motion, there is placed upon the internal surface of the cylinders an iron track upon which runs a locomotive moved by electricity. As soon as this locomotive begins to run, the large cylinders will begin to revolve. The inventor has found by experiment that a very large wheel revolves with greater ease when the motive power is applied as described above. The height of the engine has considerable influence in proportion to its weight, and a very high speed ought thus to be obtained. What will the latter be? Mr.

Chapman cannot say, but he sees no reason why it should be less than that of the modern railways.

The trip from the United States to England might be made in three days or even in forty-eight hours. There would thus be greater chances of passengers making such a trip without seasickness. Here and there, upon the generatrices of the cylinders, there are projections that will cause the latter to move forward instead of simply revolving. Besides, in the center of the height of each cylinder, and at right angles with the generatrices, there is arranged a projection that is higher than the preceding and that will subserve the same purpose as the keels of the present ships. Rudders may be placed at the stern on each side and be connected with the fixed axes.

With cylinders of a hundred feet or more and a space of from four to five hundred feet between the two, rolling and, consequently, seasickness will be almost entirely prevented.

It is well to remark that the locomotive will always keep the same position with respect to the axes, that is to say, at the bottom of the cylinder, whatever be the speed. In this way, it is possible to enter the interior of the hollow axes through the lateral foot bridges, and from there to ascend by a ladder to the engine.

The most interesting part of the invention consists in the reduction of the net cost. It is possible, in fact, to save nine-tenths and even nineteen-twentieths over the price of an ordinary vessel. Instead of huge boilers and engines that necessitate an army of stokers, there will be need of but two locomotives. In cases in which a great speed would not be obtained, the diminution in the net cost would again render the invention useful, particularly if it were a question of operating upon rivers or canals, where freight charges should be low. It is the great problem of the future to be able to increase the speed of ships upon canals without injuring the banks. Screws and paddle wheels are not practical, on account of the violent motion of the water that they produce. With this new vessel, the cylinders will simply roll over the water without the least agitation of the latter, even at the highest speed of the largest ocean steamers.

As may be seen from this brief description, Chapman's roller boat must have the same qualities as Bazin's. It is probable that the results anticipated by the inventor have not been obtained, for, since 1895, this new boat, which was to revolutionize the art of naval construction, has not been heard of. We hope that the Bazin roller boat will have more success than its predecessor.—*La Nature.*

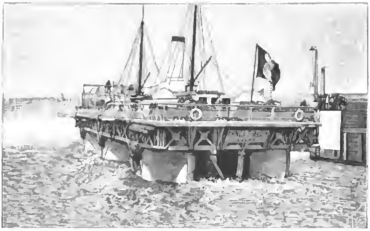


FIG. 4.—GENERAL VIEW OF THE BAZIN ROLLER BOAT.

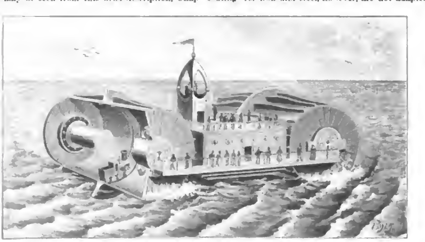


FIG. 5.—THE CHAPMAN ROLLER BOAT.

On October 19 the Illinois Steel Company turned out 1,248 tons of rails and billets on the day shift of 12 hours and 1,160 on the night shift, or 2,408 tons in 24 hours. They expected to turn out 47,000 tons in [illegible]orld's record.

NOTES ON THE YACHT DEFENDER AND THE USE OF ALUMINUM IN MARINE CONSTRUCTION.

By RICHMOND PEARSON HOBSON, Assistant Naval Constructor, U.S.N.

IN a paper contributed to the United States Naval Institute, Annapolis, Md., Mr. Hobson presents an exhaustive scientific report on the construction of the Defender and other aluminum craft, the corrosion of aluminum from salt water, and the present and future uses of aluminum in marine construction. The complete text of the paper is published in a recent number of the Institute. In reviewing the subject of corrosion Mr. Hobson writes as follows:

The experience in actual service and the experiments made are inadequate to a definite and final conclusion as to the corrosion of aluminum in salt air and salt water.

The consensus, however, would lead to the following general conclusions:

1. When isolated, pure aluminum is not attacked.

2. When isolated, the usual alloys of aluminum and commercial aluminum are attacked in a measure more or less proportional to the amount or per cent. of the alloy or impurities. Among the alloys, copper and zinc seem the most corrodible.

3. When in contact or communication with other metals below it in electrochemical scale, galvanic action sets in and aluminum and its alloys are rapidly corroded. The action takes place when the contact is between different alloys of aluminum and even between different pieces of the same alloy, when not homogeneous; and there is indication that the corrosion of isolated alloys is probably due, in large measure, to the galvanic action between the particles of the two metals in the body of the alloy. Copper is again the metal whose contact causes most accentuated action, and the copper alloy is the alloy in which galvanic action is most marked.

4. The conditions of corrosion can be ameliorated by the application of coatings and covering. The usual coatings for iron and steel, however, are not adapted to aluminum, particularly red lead. In case of special coatings, as yet prepared, special care and frequency of application are required. It would seem that the special characteristic to be sought is impermeability.

While drawing the above conclusions on corrosion, the imperfect behavior of steel and iron should be borne in mind. With full appreciation of this imperfection, however, the comparison of the two metals gives the following general results:

1. At the present stage, structural aluminum is materially more subject to corrosion than steel. The marked corrosion, however, must be attributed to galvanic action due to the high electropositive character of aluminum, the pure metal itself, practically incorrodible, being far ahead of steel, and to this galvanic action must be attributed the corrosion of alloys and the usual commercial aluminum where even there is no external contact with other metals, the action taking place in the body of the metal from the intimate contact of the molecules of aluminum with the molecules of the alloying metals or impurities.

2. This feature of inferiority must therefore be regarded as subject to future amelioration from increase of knowledge and selection in the preparation of the alloys and from improvement in conditions of insulation and protection. Substantial amelioration has already been found in the use of nickel for the alloy, without entailing loss of strength, while further amelioration seems promised in the use of tungsten for the alloy.

Special measures toward insulation seem not to have been taken or tested in any case.

3. The coatings used for painting steel are not effective in protecting aluminum, and the special coatings as yet prepared are but partially effective, and then only on condition of special care and frequent renewal.

4. This feature of inferiority must likewise be regarded as subject to future amelioration with further experiment and increase of knowledge. It could scarcely be expected to find a suitable coating without research, particularly when the usual coatings for steel are composed so largely of oxides of metals whose contact with aluminum sets up galvanic action.

5. The degree of importance of the inferiority of aluminum to steel in the question of corrosion varies with the conditions of exposure, and is disqualifying when the exposure to salt water and spray is constant and where frequent visitation is difficult or impracticable.

The cost of maintenance and care and the length of life identify themselves, as seen above, with the question of corrosion. Without being able, evidently, to assign definite values, the cost of maintenance and care at the present moment must be taken as appreciably greater for aluminum than for steel. The cost of additional care is not of great consequence for parts easily accessible, provided the exposure is not great and the coatings applied or the other process of care are at all effective. For parts constantly exposed, multiply the frequency of visitation; the additional cost is considerable, particularly where the parts are difficult of access. In such cases of exposure and difficulty of visitation, the inferior conditions of preservation reduce the length of life, which, under good conditions even, must be considered as shorter than the life of steel. This factor of cost takes on large proportions and, at the present moment, must be considered prohibitory for waterwashed surfaces and parts in contact with bilge water, while still of large consequence for all outside parts, topsides, upper works and upper deck fittings.

The results of the comparisons for strength and weight and for cost lead to the conclusion that at present aluminum is adapted for use in hull work for bulkheads, casings and trunks, small trunks and ducts, hammock berthing and metal ceiling, and for use in hull fittings for parts of ventilation system, for metal doors, hatches, torpedo ports and coaling ports, metal ladders and gratings, masts and spars, this adoption in the case of a 9,000 ton vessel realizing a saving in weight of about 380 tons, at an increase of about $250,000.

The same results lead to the conclusion that as soon as an efficient coating is found, aluminum will be further adapted for the bottom plating of sheathed vessels, for the bottom and topside plating of small vessels, part of the topside plating of large vessels, for bottom and topside framing of small vessels, for topside framing of large vessels, for the bottom framing of large vessels, except outer angles in double bottom, for inner bottom plating, and deck plating, and for dead light, airport and deck light frames and casings, realizing by this adoption in a 9,000 ton vessel a saving in weight of about 380 tons, at an increase of cost of about $260,000.

It is to be remarked that in the above applications it is assumed that galvanic action does not set in from the contact of aluminum and steel, an assumption apparently justified by experience thus far; but, in course of time, it is largely probable that appreciable action would set in, if some insulating provision were not made in the joints between the two metals. It is not believed, however, that such insulation provision would be impracticable.

It may be recalled, also, as stated in the outset, that performances and homogeneity of aluminum as taken are somewhat ahead of the present stage of manufacture, and that the applications have been extended to dimensions and scantlings not yet commercially turned out.

Moreover, it should not be overlooked that the element of cost in the maintenance and care of aluminum construction and the length of life are not well determined and are difficult to valuate on account of the limited experience.

The results arrived at are thus to be taken in connection with the limitations necessarily imposed by the fact of the field being essentially new.

In summation and in conclusion, aluminum has incontestable virtues as a structural material. Its great elastic elongation and resistance within the elastic limit places it far ahead of steel for resisting usual, well determined and repeated dynamic forces, while its great comparative lightness marks it for marine construction. On the other hand, it has serious defects. An excessively low elongation beyond the elastic limit unfits it entirely for use where liable to be subjected to violence and unknown dynamic forces; temperatures beyond atmospheric undermine its physical properties; while notwithstanding an innate superior resistance when pure to the attack of corroding agents, the high position on the electrochemical scale, causing excessive tendency to galvanic action, places a severe obstacle in the way of adoption where exposed to salt water and spray, particularly in the case of alloys, in which form alone the metal exhibits its best properties. This last serious defect, however, must be considered as subject to constant amelioration with increase of knowledge and experiment in precautions and higher perfection in manufacture.

Thus, while this new metal has an important field in marine construction, an important field now ready for occupation and additional fields awaiting only the improvement in conditions for resisting galvanic action, these fields are essentially limited, and the larger domains are shut out by impassable barriers.

The early optimist who inferred all virtues from a

single virtue, and the latter reactionist who pronounced general unfitness from a few partial trials, were both wide of the mark. The metal is not Utopian, but it has nevertheless beyond question an important mission for the serious marine architect, who is only waiting further improvement in manufacture and reduction in cost and further amelioration in conditions of corrosion.

For the naval architect of our own country, for our country itself, the question has a special significance.

The maintenance of a strong commissioned naval force must be our country's policy for taking its destined part of international greatness in regulating the common affairs of the planet, but our position and the spirit of the nation marks our naval policy specially for a great force kept economically in reserve commissioned only periodically for drill purposes.

In a state of reserve the conditions of corrosion are greatly ameliorated. The vessels seek and lie in fresh water; the torpedo boats and small boats, which do not seek fresh water, are hauled up under sheds. Under these conditions the great obstacle of corrosion is largely removed from aluminum's path. Indeed, aluminum appears to be superior to steel in resistance to the corroding effects of atmospheric exposure and of fresh water.

The question becomes more significant where account is taken of the great natural facilities and possibilities of our coast line for fresh water basins of large expanse for taking vessels of all sizes. It takes on a still more significant aspect when it is recognized that nature in the inland routes along the coast has marked small craft as our great second line of defense, while in the inland waters of great rivers and great lakes in communication with the sea she has provided immeasurable possibilities for the construction and maintenance of these craft.

Torpedo boats, which are thus marked for a great natural economical branch of national defense, form now the least developed arm of our navy.

There therefore lies ahead, inevitably, a vast programme of torpedo boat construction, for which every advantage of materials of construction should be earnestly sought. Fortunately for the nation, this branch of defense admits of rapid growth and may be expected to have large expansion in the near future. Indeed, the time is not very far distant when, with treaty restrictions abrogated, we shall see on the great lakes vast flotillas of torpedo boats, lying for most of the year in economical reserve free from corrosion. Periodically they will be commissioned for drill purposes and from time to time will sally forth to the seaboard for mobilization and exercise in the operations of coast defense.

We would realize thus, at a minimum cost and a minimum turning away of the nation's energies from the channels of production, a great power, tranquil in time of peace and good will, irresistible for defense in time of war.—Aluminum World.

THE CONDITION OF THE LABORING CLASSES IN MEXICO.

UNDER the joint auspices of the Franklin Institute and the Young Men's Christian Association, Mr. Theodore C. Knauff recently delivered, at Association Hall, Philadelphia, an illustrated lecture under the above title, from which the following excerpts are taken.

A year ago a newspaper paragraph said, "Why is it that the Mexican peon with his sixty cents a day is making more than the American farmer with all his knowledge and invested capital?" The untruthfulness of this parallel is proved by a trip to Mexico to study the peon's life, followed by a trip through Iowa, Wisconsin, etc., to see how the American farmer lives, personally, what percentage are mortgaged, what have paid off their mortgages, what have a bank account and what percentage have money loaned out at interest. In the last presidential campaign Mexico was held up as a great country for the manufacturer and far beyond our own in prosperity; that thither the workingman must go to find the only prosperity then obtainable.

Mexico is not such an insignificant country compared with ours, either in size or wealth; and it was a land of comparatively advanced civilization long before Columbus discovered America, having a representative government and a fairly complete system of laws. With the European advent into and conquest of Mexico she received and absorbed all that was then known of eastern civilization, at a time when all but a very small proportion of this country was inhabited by savages. After a year's exhaustive study of the subject, Mexico now has a certain amount of prosperity; but she went to sleep for several centuries through religious intolerance and did nothing; suffering also from instability and mismanagement in government and from internecine wars. A long series of years overcame all this; she lived again, though behind in the race; and in her effort to catch up developed great opportunities for capital. To that extent it was a newer country than our own, with more chances. About 1890, suffering through a long disaster, from an unmanageable foreign debt, she tried to lift it by virtual repudiation; the man owning a dollar in Mexico knew not how long it would be his; or, having a dollar loaned, how soon he could get it back. Mexico is a silver country, not only by this monetary basis, but as a producer of silver, all its interests, all its industries, are wrapped up in this product, constituting 60 per cent. of her exports to-day.

At a most critical time President Diaz was confronted with an enormous decline in the value of this national commodity, which must be measured by the foreign product; he faced a great foreign debt contracted in gold, principal and interest—having naught but silver wherewith to pay. $100,000,000 was the gold debt, besides additional debt contracted in silver. That gold debt, comparing the number of their people with ours, is as large as all our national debt; and much larger, comparing the quality of their people with ours. Mexico wanted to borrow money. Should she pay this debt in depreciated silver and thus virtually ruin her reputation? It meant stagnation and ruin. If she simply went to work and paid her debt (just double in face value what she had contracted to pay), that meant stability. Diaz undertook the great task of getting just double this amount of money, which in his country took just twice as long to get—very expensive process, but it paid in the end. To-day, when Mexico wants more money (which she always does), she can get it. The foreigner will loan it, because he knows it will be paid back. Mexico has many multimillionaires who live there and will loan their money to the country; there must be activity and what we call prosperity under such circumstances. Here is the admitted prosperity of Mexico; who benefits by it? Has she been a haven for the unemployed? No. Labor is governed, among other things, by the law of supply and demand. So is capital. Here is a country needing capital, and it is in short supply. On the other hand, here was a country having an unlimited amount of labor, very low priced and largely unemployed, ignorant, and so indolent it was incapable through improved conditions to help itself along; consequently, there was no rise in the price of labor. The wealthy man came along and enriched himself under the advantage of low-priced labor, was invited to go there and virtually wring his profits out of the workingman. It was not a place for the workingman, but for wealthy men to make money out of the workingman. Their low-priced labor is the greatest inducement they put forward for foreign capital. The American silver mine operator is attracted there because the Mexican smelter or miner works for half what the American does and is contented. He lives, apparently happy, on food in quantity not enough for an American child and in quality not the proper thing for an American hog. This cheap labor has been the very source of this cheap money; and this workingman has borne the brunt of what has taken all the efforts of the country to lift in the way of debt. There is no country in the world that is better for monopolies and trusts than Mexico. What has she paid for her prosperity? She is borrowing money all the time to meet the great deficiencies; no means of raising revenue are neglected, and they are all borne by the workingman. If the workingman wants a little delicacy, or a little amusement, he must pay for it in the way of taxes. It is only lately that a middle class has begun to spring up. The wealthy American individual or corporation, going there, puts out money under great concessions—getting advantages virtually wiping out taxation. So, too, the great Mexican land owners form so strong a combination as to virtually rule the country and practically exempt themselves from taxation. The rest comes out of the poor man or the middle class man.

This new Mexico, which is the result of foreign and domestic capital being spent, is apt to be neglected. Because there is so much of the workingman that is picturesque, we neglect the rich man. We went to see how this workingman lives; how he is housed and clothed.

A map of Mexico, projected upon a United States map of the same scale, extends from Maine to Texas. Mexico is sixteen times the size of New York State; Sonora equals Indiana and Ohio combined; Chihuahua, Pennsylvania and New York combined. Mexico's mountain system is a continuation of the Andes widening out into two ranges, leaving in the middle a high, flat tableland, 4,000 to 8,000 feet high, with a volcanic range through it reaching 18,000 feet. The citizens of the capital, Mexico, at 8,000 feet, are 2,000 feet higher than Mount Washington all the time. We feel that altitude, the dryness and rarefaction of the air; and we do a great many things, from atmospheric and surrounding conditions, that we would not do in our own country. Altitudes affect climates more than latitudes. Entering Mexico from El Paso, Texas, we cross over from Torreon on the International Railway to Monterey and Tampico (the latter a seaport); then climb the mountains again to San Luis Potosi on the tableland. At Guadalajara is the great gate made shortly after Cortez entered the country; thence down into the city of Mexico and along the trail of Cortez through some of the grandest scenery in the world, to the seaport Vera Cruz.

Egypt is the only country equaling Mexico in fullness of interest for travelers; and no other frontier in the world presents changes so sudden and so marked as that at El Paso. Everything on the American side looks prosperity; the express wagons, the Pullman coaches, the ordinary American citizen, freight houses, oil shops and factories. Crossing by almost a dry ditch (the water being used for irrigation purposes) to the opposite Mexican town, we pass, in a few seconds, to conditions changed as by a magician's wand. For coats, we have blankets; for hats, sombreros; for prosperity, poverty, by appearance; for a self-respecting population, loafers and beggars; the greatest possible interest in our arrival, the town turning out as to the one event in their lives, conveying the impression that no occupation whatever could be found in the place.

Mexico's population is 12,570,000, two-thirds of whom never slept in a bed, wore stockings, rode or had an ancestor that knew how to ride; and they live to-day at a less expense per man than it costs us to keep the meanest farm horse. Fifteen years ago travelers could not go around unattended. One of the first persons we meet on entering any of the towns in Mexico is the brigand. The Mexican government, when necessity demanded, took two ways of ridding itself of them: one, by sending out troops, putting him against a wall and shooting him; but the leaders were turned into soldiers and put there to catch brigands—a very successful proceeding. The flower of the Mexican army to-day is the Rurale, or rural fellows, the most expert soldiers and riders; at every railroad station are two of them detailed to guard the train and preserve order. The rails of the track bear the best known English stamp or come from Krupp's, in Germany. Iron is very scarce and dear in Mexico, simply for want of capital to get it out. Near the station of Durango is a mountain of nearly solid iron, assaying 90 per cent. metallic iron—enough to supply the world 300 years; but within a very few years iron was sold there for 35 cents per pound.

By whatever route you enter Mexico you must necessarily pass over a desert. In the northern part it only rains during the summer months, and then not even every year. So on all trains the locomotive carries an extra tank car. The question of transportation and the scarcity of water are two pressing problems in that country to-day. Wood costs $12 to $18 wholesale; and what there is has to be cut for railway ties, except when they use iron ties. Coal is also scarce, although there is plenty along the railroads, but it has not yet been mined. The Vera Cruz Railroad imports its coal from England at $20 per ton; while the roads in the north get theirs from Colorado.

On the Mexican tableland the houses are almost universally built of adobe, simply a large block of mud pressed into shape in a mould, then hardened and baked in the sun and laid in flat layers, one on top of the other, in walls 20 inches thick. It makes quite a substantial building, requiring a long time, even in the rainy season, for the water to soak through the walls. A church and a plaza are required before a settlement can be a city. The Mexican farm laborers and their conditions are far inferior to those of the late slaves of our Southern States. The huts have but one opening; no window; no drainage; dirt floors; and the occupants, regardless of sex, wishing to go to bed, simply unroll their mats and, without removing clothing, go to sleep. There are no seats, no utensils other than the pots for cooking and mill for grinding corn. The farm laborer has a certain wage and is given time and place to build himself this house; if he does not build it, he has no house. All these houses are built by the people who live in them. They vary, in some places being mud roofed, in others roofed by palms, or banana leaves or some fiber that will shed moisture when necessary. In the city, they look to the eye as if not built of this mud material, but are exactly similar, except the exterior is plaster coated, resembling our pebbledash. Outside is no particular mark of beauty; but within, the pateo, or hollow square, is bespangled with flowers and very homelike in its surroundings.

The city streets present all one-story houses; dirt floored or tile floored. If any one is so extravagant as to own a carpet, that is put down directly in the doorway. Ventilation is unprovided for, and were it not for the exceedingly dry air, due to the elevation and absence of moisture, the mortality would be frightful. City houses of a better class are made of stone. In constructing an arched extrance they build a form the size and shape of the arch and then build upon it, and when the keystone is in place they take the form away. Many of the houses are unfinished, not because they have not had time, but they do not want to do the work. Also, in some towns, all finished houses are subject to tax; therefore, a great many houses are unfinished. This is the condition, also, of a certain railroad in Yucatan which is being built under government subvention, which subvention they were to receive only until the road was finished. That road, for some twenty years, has been within one mile of being finished.

To see a man working a modern sewing machine in the street is not unusual. All branches of trade are carried on outside in that way. Should you want your shoes repaired, you will find a cobbler on the sidewalk or at the curb, wherever it is convenient for him to be. A policeman on duty in a certain municipality I noticed attending to a piece of knitting; in another, one of the regular government sentries, near a government station, on sentry duty, with bayoneted gun leaning against a wall, while he engaged in what the ladies call their "drawn work"—embroidery.

The wealthy families in the three and four story houses live upon the upper floors and don't care who occupies the others. A person of means has invited you to dinner; you find, after considerable trouble, the stairway and eventually a very small bell pull with his official title underneath. You ring and are at once ushered into the greatest magnificence—all kinds of comforts; and there you find genuine Mexican hospitality, the usual speech (in Spanish) being "The house is yours."

There are shops, but business is conducted largely by peddlers and sidewalk merchants. You find not the shop owner's name over the doorway, but instead an official title, which is the name of the shop. Mexican bread is raised with pulque (the equivalent of yeast) and is always sour, and the bake shop where we tried to get something approaching Mexican bread that we could eat bore the name over the door "La Favorita." A druggist's name, being translated, was "Gate of Heaven." Another was a saloon and bore the name "Port of New York." In still another town (probably a prohibition town) the saloon was called "The Triumphs of the Devil."

In the neighborhood of Zacatecas we found the people gathered about noon around the central fountain. This is a town in which the water is very scarce indeed, the central fountain being the town's sole supply, and the fountain deficient at that. The people have to come very early to get a supply for the day. The supply that comes in the night runs out very quickly, and they have to take the water up in little scoops until the vessel is full. I have been asked, If this be true, what do they drink? There is plenty of water to drink, but not enough for ordinary purposes from our standpoint.

The women wear a kind of cotton shawl over the head or shoulders called a reboza, and the men a woolen garment called a sarappe. Transportation is forced upon our attention, because at every turn on the railroads we see the primitive oxen carts of Cortez' day beside our modern train—an ox cart whose wheel is of three solid pieces of wood. The people who run those wagons—the teamsters—get for their pay fifty cents Mexican per day. The teams themselves are owned by the wealthy proprietors. The oxen are hitched, not by a yoke, but by being tied to the horns—the strongest part of the animal.

The railway traverses a region of great border farms; on both sides, at one place, for eighty miles, is all one large landed estate, belonging to one individual. In another place one estate has 1,500,000 acres; in another, 250,000 acres. Out of a total population of 12,570,000, 6,000 people own all the land, with influence enough to avoid, practically, all taxation, which falls on the poor; and so there is no middle class. At present there is little danger of an uprising of the people, because they are generally content; and if they had a leader there to create an uprising, no one would follow him. The giant cactus grows there—a variety of what we call the prickly pear—bearing a fruit; the leaves are fed to cattle after burning off the thorns, and it is the national plant of Mexico, seen on the Mexican dollar. A species of this plant was used to feed the cochineal insect until the use of aniline colors threw cochineal out of the market; in fact, all the vegetation of the country seems to wear a thorn.

The sarappe, the ordinary garment of the Mexican, is quite thick and of wool; and you might think the people were suffering from the cold. One garment is his coat—sometimes his hat; it is his bed, and numerous other things. It is made usually with a slit or hole in the middle; and when a man is liable to do anything else and wants the use of his arms, he pokes his head through the hole, and when he does not want to do that way, the hole is simply sewed up and he wraps the garment around him.

The feet are usually bare or clothed in a domestic sandal. We sometimes see a white cotton garment, more suitable for the hot countries; but strange to say, we find more of that kind in the tableland, where it is cold, and the sarappe in the lower land, where it is hotter. They simply reverse things. When Cortez entered the country he found the natives all clothed in cotton; it is the native plant; and the armor of the soldiers of the Aztecs who fought Cortez was made of quilted cotton, made to turn back the arrows used between those Indian tribes, but affording no protection at all against the firearms of the Spaniards. In some cases, when our pegged shoes have been sold in Mexico, it has been found that the air is so dry that the pegs drop out and the soles come off, when the soles are used as sandals.

There are to-day in Mexico pure breed Indians—Aztecs of exactly the kind that fought against Cortez; of pure blood, speaking the Aztec language; some of them may be found in the streets of Mexico, and they are of a peculiar bright red—very clannish; they could not have preserved their integrity if they had not been. There are twenty-five original languages of the Indians spoken in the country to-day. All grades of peons are more of the Indian type; but they range all the way from that common class of mixed blood up to nearly pure, true Spanish blood.

The better class, instead of the cotton roboza, wear a shawl, usually black; and the members of this class will not mix with the lower class. The girls in this class work sometimes in factories managed by Northerners at drawn work; some doing it at home, others in the shops, at so much per day. The former go to the factory; get their bundle (a foot long by three inches in diameter) to take home; but so proud are they that they hire a peon to carry it home for a cent or two.

Oil is a great necessity both for light and fuel; but they cannot buy it for any reasonable figure; there is the duty in the first place to pay (a difference in the standard money of more than double), then the risk that has to be taken on it; so that it takes three times the value of the produce to buy it in Mexico, and they must have these outside products. Could a man live on the products of Mexico, he would live very cheaply; but he must have outside products for comfort. Until very lately the products of Mexico were the same, silver bought as much as it ever did; but this last sharp decline in silver has broken the camel's back, and now silver does not buy as much as it ever did and the cost of living has increased, without an increase in the wages, and the excuse the ordinary salesman will make for charging a higher price in Mexico is, as he says, the change in the price of silver.

The burro is the great institution of the country. He will carry more than his own weight and carry it till he drops. The transportation question is being settled now by the railroads being built under a government subvention of from $6,500 to $9,500 per kilometer, about one-fourth of the cost of the railroad, and that is paid in revenue bonds, and six per cent. of the customs duties must be set aside to redeem these bonds. The engineer has charge of the train, while the conductor is a Mexican. But the engine driver runs when he is ready, and not before. Coffee in sacks costs 3 cents per pound additional for transportation 40 miles off the line of the railway and is worth nothing at the distance of 120 miles. The culture of the grape and the silkworm culture was introduced by a reformer in 1810; but the Spanish government wanted to keep the revenue of the colony and so it destroyed all the vines, silk and mulberry trees; and that was part of the many difficulties which led to the rebellion which finally expelled the Spaniards from the country. There are a good many forms of sisal fiber, all coming from a species of maguey, Agave Americana is one particular form from which sisal is made. The Mexican hammocks, coming from Yucatan, are made from sisal. There is another form called henequin; another fiber from the banana leaf, all kinds of articles are made from it; rope, brushes, shoes, bags, fans, carpets, saddles, hats, everything, fibers for ladies' corsets in this country. The straw is thrashed by trampling out by the feet of oxen. Our modern thrashing machine has been introduced; but it is not popular, it makes too much work; it leaves the straw whole. The Mexican wants the straw all broken up by the same thing that gets the grain out, so that it is ready to feed to the cattle. Labor is cheaper than lumber in the country; and that is particularly shown in the way they weigh commodities. Instead of putting up a wooden spar to hold a cross beam, from which the scales may be suspended, they will walk two men around all day with one beam on their shoulders. Whenever an article is to be weighed, these men take the beam and put it across their shoulders and thus become a part of the scale. The Mexican burro owner is very tender of his pets, cats and domestic animals, but not of his beasts of burden; he never hesitates to get on top of a burro, no matter how heavily he is laden. The man rides the burro; his wife walks behind; and if there is anything to carry, his wife carries it. When a company of soldiers moves from one post to another, there is a company of wives following after, and the government recognizes it; because they virtually act as a commissary, and the government does not have to cook for the troops. The priests introduced the burro as an animal to relieve the overworked laboring man, or in the interests of humanity; but the porters, preceding the burro, opposed it as a labor-saving device calculated to prevent them from earning a living. The peon is opposed to improvements, machinery or anything else; and they will carry these big loads in preference to giving them to a burro, carrying, in some cases, 150 pounds 20 miles daily.

At death, Mexicans, unless very wealthy, are put in little pigeon holes formed in masonry above ground, for seven years, and the rental must be paid in advance. W[illegible] the term has expired, the body will be [illegible] ess the rent be again paid. The body dries up in that rarefied air, and, if taken out, is set up against the side of the vault.

Guadalajara is noted for its pottery works. The market place for pottery or any other kind of work is best seen on the universal market day—Sunday. When the fashionable are at church, all the rest of the country is at market. It is a very wealthy town of some forty-seven millionaires. All business stops at midday for at least two hours; all the tramcars stop; all the building operations stop; the post office closes; you cannot get a letter. It is troublesome in most towns to get a letter. You used to have to wait until the list of all the received letters was posted on the outside of the office. In all but the city of Mexico every post office closes for two hours in the middle of the day and everything stops on account of the intensity of the heat. You will feel cold when the sun is off on account of the altitude. The difference between the sun and shade is the difference between 90° and 70°; and the difference between day time and night time is the difference between 70° and 40°.

THE CALCIUM CARBIDE INDUSTRY.

CALCIUM carbide and acetylene gas still continue to rival bicycles and incandescence mantles in their attractions for the genus "inventor" of this and other countries. In the first half of the present year there were no less than 117 applications for patents dealing with the apparatus for the production or utilization of calcium carbide and acetylene gas; and the total number of applications for patents in the present year will, therefore, most probably exceed that of 1896 by at least 50. These numbers must not be taken too seriously. One may very safely assume that at least 300 of the 400 and odd patents which have been granted are absolutely valueless. In Germany, where the validity of patents is settled in the Patent Office, and not in the law courts, as in our own country, a struggle is at present being carried on concerning the validity of the patent covering the production of calcium carbide in the electric furnace. This master patent was granted to Bullier, a French chemist and assistant to the noted Moissan, whose experiments upon the products of high temperature reaction in the electric furnace have become classic. Although the German carbide manufacturers are stated to have entered into treaty for the purchase of this German patent from the syndicate who hold it, the question as to validity is still unsettled.

In view of the large number of patents that exist bearing upon calcium carbide and acetylene, and of the exaggerated ideas that have been fostered concerning the future of the latter as an illuminating agent, it is not surprising that the craze for company promotion which marked the rediscovery of the compound in 1893 has continued during the present year. At least twelve new companies have been registered during the last twelve months, having as their object the production or exploitation of calcium carbide or acetylene gas. The nominal capital of these companies is over £550,000, and it would be exceedingly interesting to know what proportion of this has actually been subscribed by the general public, and also what is the amount of cash that has found its way into the pockets of patentees and company promoters connected with these twelve companies. Of this total, four are in our own country; but, so far as we know, not one of them has started to manufacture carbide.

The number of factories where carbide is at present produced is estimated at seventeen; only one of these is in this country—that owned by the Acetylene Illuminating Company and situated at Foyers, Scotland. Most of these factories are only producing carbide upon a small scale, and in several cases the manufacture is simply a secondary one, taken up temporarily because the price of carbide is still inflated, and the production offers more profit than the ordinary manufactured product of the works. When the industry has settled down on a firmer basis, these factories will, possibly, drop the manufacture. With regard to the output of carbide per electrical horse power day, and to the cost of production, some of the earlier estimates are held to have been too favorable, and it is now believed that the output will not average more than 9 pounds of carbide per electrical horse power day, and that the cost will be about £10 per ton.

Prof. Vivian Lewes has recently stated that at Foyers the average yield is 8·4 pounds per electrical horse power day from a furnace absorbing 1,000 to 1,200 amperes at 60 to 70 volts pressure. With carbide at £10 per ton, acetylene gas will cost about 18s. 8d. per 1,000 cubic feet, without any allowance for the cost of generating and purifying it, and its use as an illuminating agent will be correspondingly limited. M. Patin, of Paris, has recently applied for a patent for a process which is stated to cheapen the production of the carbide, but no details of this process have yet been published.

As regards the use of acetylene or of calcium carbide there is little progress to report. The instances in which acetylene is being regularly used as an illuminant, i. e., other than for experimental or advertising purposes, are very few. The majority of recent patents have related to generators for the production of acetylene gas from calcium carbide. The reaction between the water and the dry calcium carbide is extremely violent, and in one of the earlier forms of generator much advertised and sold, the apparatus on newly charging always produced an escape of gas into the atmosphere. This defect is said to be avoided in some of the later forms. A certain and ready detector for this defect in generators is one's nose; for acetylene rivals sulphureted hydrogen gas in the objectionable character of its odor. A recent patent proposes to avoid this difficulty by casting the carbide into sticks, and by then soaking these in naphtha or in heavy hydrocarbon oils. Acetylene has recently been experimented with as a lighting agent for trains in France and Germany; and it was stated not very long ago that the authorities in the latter country had ordered 20 tons calcium carbide for experimental purposes.

Prof. Vivian Lewes has recently discussed the application of acetylene as a ship's illuminant, and Warren has suggested the use of calcium carbide as a reducing agent in metallurgical operations. By heating together calcium carbide and metallic oxides he has obtained the metals or alloys of the metals with calcium. The present market for carbide is chiefly due to the demand for experimental or advertising purposes, and a legitimate demand for this much boomed product can hardly yet be said to exist.

With regard to the properties of gaseous and liquid acetylene, there have been a considerable number of facts published lately, and some useful information has also been given concerning the precautions which it is necessary to take in dealing with acetylene in either form. A few of the more interesting of these are given below. Acetylene does not combine with the hæmoglobin of the blood. It produces death when inhaled, simply by asphyxiation. If a vessel containing liquid acetylene be allowed to receive a blow, or to fall from a height of 6 meters to the ground, explosion with actual combustion of the acetylene will occur; if, however, the liquid acetylene be detonated by means of an incandescent platinum wire, a mere resolution of the acetylene into its elements, carbon and hydrogen, without combustion, occurs. The pressure generated in the former case is said to be equal to 5,564 atmospheres. If too little water be used in the generators when producing acetylene gas from the carbide, the heat of the reaction between the latter and the water may rise so high that an explosion will occur. The acetylene generated from commercial calcium carbide is always impure, and it should certainly be purified before use, especially if it is to be stored in a gasholder for any length of time. Phosphureted hydrogen, its most dangerous impurity, can be removed by passing the acetylene through scrubbers containing solutions of metallic salts.

Pictet recommends that the gas should be passed successively through calcium chloride solution, a lead salt solution, and sulphuric acid at −16° C., if it is to be compressed or liquefied for storage purposes. A much safer method of storing is, however, to use acetone for absorbing the gas. This chemical absorbs twenty-five times its own volume of acetylene at the normal temperature and pressure, and 300 times its own volume of the gas at a pressure of twelve atmospheres. If acetylene is to be stored in an ordinary gasholder, brine should be used in place of water for sealing the apparatus, since the gas is practically insoluble in the former. Acetylene is inferior to benzine in economy as an enricher of coal gas. The consumptions of acetylene and coal gas per candle power hour in various types of burners are as follows:

Acetylene			0·0227—0·0282 cu. ft.
Coal gas	Non-incandescence burners.	Bat's wing	0·406 "
		Argand	0·353 "
		Siemens	0·130 "
	Incandescence burner.	Auer's	0·095 "

These figures show how remarkably the introduction of incandescence lighting has improved the position of coal gas as an illuminant, and how difficult it will be for acetylene to displace the latter, except in those places where the price of coal gas is abnormally high. The incandescence principle has now been applied successfully to oil lamps. This fact still further handicaps the progress of acetylene as a lighting agent, since it is largely robbed of its most distinctive feature—its brilliancy—by the improvement in gas and oil illumination obtained by the application of the incandescence principle to burners and lamps. The high illuminating power of the acetylene flame is stated to be due to the exceedingly high temperature of the carbon particles: this temperature is believed to be nearly 4,000° C.—Engineering.

LAFCADIO HEARN ON JAPANESE ART.

NUMBER fifteen of the Taiyo contains an article from the pen of Mr. Lafcadio Hearn entitled Nihon Kaiga-ron (Japanese painting), of which we give a short summary. At a meeting of the Japan Society held in London last year, Mr. Edward Strange read a paper on Japanese painting, in which he spoke in laudatory terms of the peculiarities of Japanese art. This evoked a great deal of opposition and a warm discussion ensued. Among other things, it was said that no such woman as is sketched by the Japanese artist was ever seen. The question caused so much excitement that the Japanese minister, Mr. Kato, in order to quiet the feelings of the combatants, turned the discussion into another channel. The objections to Mr. Strange's view were evidently founded on want of initiation into the mysteries of Japanese art. This art requires special study. My own experience was that at first Japanese painting seemed anything but attractive, but after two years' study I began to see something charming in it, and from that time it grew on me until it appeared no other than marvelous. A Japanese studying western art would no doubt undergo a similar experience.

The characteristics of Japanese art which have special merit I will now endeavor to indicate: 1. The relation of individual objects to a given type, the subjection of special characteristics to an all-prevailing nature are invariably observed. By a few clever strokes of the brush an insect or a flower is made at once to declare its identity and to show its relation to the family to which it belongs. Rather than Nature herself, he prefers to embody the idea which she suggests. 2. In Japanese portrait painting. In accordance with that strong national trait which makes the suppression and concealment of emotion meritorious, there is no attempt to represent passing states of feeling. From their pictures it is difficult to decide whether a person is old or young, good or bad, much less the state of feeling of the individual represented. The high regard in which an absolutely passionless state is held may be traced to Buddhism. 3. In ordinary foreign painting great minuteness is aimed at, but the Japanese think more of general effect. Both styles have their advantages, though to carry minuteness to an extreme is considered vulgar even in the West. What are called Ukiyoye convey to my mind a most vivid impression of passing scenes, but this impression is not caused by the faithfulness of these sketches to details—by their reproduction of actually existing objects—but by a certain subtle suggestiveness which they possess. All high class art deals with the ideal rather than the real. The finest productions of Greece were founded on religious, or at any rate on transcendental, conceptions. There is a point where the art that is the result of special study and the art that comes from intuition meet, resulting in the creation of beauty of a very high

order. Both Greek and Japanese fine art alike remind us of the idea of Herbert Spencer's, that expression is form in the process of creation. 4. Greek art and Japanese art have much in common. They both aim at representing objects rather as they should be than as they are. The Greeks expressed their ideas respecting the gods and the aspirations of the human race. The Japanese represent the simple, unsophisticated happiness of beings who live in harmony with nature, but portray also the superiority of self control and observance of the laws that govern society. Modern western art, which is occupied with present modes of life, with the greed of the money seekers, and kindred subjects, is not only far removed from the sublime idealism of the ancient Greek, but is inferior to the Japanese standard. 5. Much depends on the proclivities of the critic in all art criticism. It takes years to become accustomed to an entirely new style. I have often been amused and instructed by listening to the unvarnished opinions of Japanese children in reference to our western pictures. Appreciation of anything valuable in the world of art involves years of laborious study. This fact is constantly overlooked by persons who undertake to pronounce an opinion on oriental art.

STRAIGHTENING A CHURCH SPIRE.

A VERY skillful piece of work has just been executed by a firm of building contractors, Messrs. Hunter & Company, of Belfast, and the details of the feat performed by the firm, viz., straightening en bloc of a church spire in the County Cork, may be of interest. For some time past, says the Irish Times, it had been noticed that the spire of Trinity Church, at Newmarket, County Cork, was considerably out of plumb, and latterly was leaning over to such an extent as to threaten to topple down on the body of the sacred edifice. Such a dangerous state of affairs could not be allowed to continue, and when Colonel and Lady Mary Aldworth returned from abroad they had steps taken immediately to have the matter remedied. This was no light undertaking, as to all appearance the work necessitated the complete taking down and rebuilding of the spire of the church. A skillful architect was engaged to inspect the church tower and spire, after which a contract was entered into with the well-known firm of Hunter & Company, Belfast, to promptly execute the work. Mr. Hunter and his staff of experienced steeple-jacks attended specially from Belfast and set about the work of taking down and rebuilding the spire, but to the surprise of all, they found that the spire could not be taken down except it was done en masse, as the stones of which it is built were hermetically bound to each other with a combination of molten lead and sand which rendered it absolutely impossible to separate one stone from another, the whole spire being, as it were, one solid block. On further and closer inspection it was found that the entire building was erected in a similar manner, no other mortar or binding substance of any kind being used save the sand and molten lead—a very curious and interesting circumstance to note. The most firm and enduring (but at the same time most expensive) form of construction was, it appears, much in use in Ireland over a century ago. A huge iron shaft runs through the top portion of the spire, on which the stones were slipped like rings and irrevocably riveted with lead and sand. Under this extraordinary circumstance the idea of taking down the tower had to be abandoned, as being quite impracticable, if not utterly impossible; but the desired end has been attained in as satisfactory a manner by an ingenious and clever method adopted by the contractor and his staff. The spire has been brought back to its original true perpendicular position, and now tapers beautifully straight, standing out very handsomely, the joints being beautifully pointed with mastic cement.

HOW WORRY AFFECTS THE BRAIN.

MODERN science, says Pharmaceutical Products, has brought to light nothing more curiously interesting than the fact that worry will kill. More remarkable still, it has been able to determine, from recent discoveries, just how worry does kill. It is believed by many scientists who have followed most carefully the growth of the science of brain diseases that scores of the deaths set down to other causes are due to worry, and that alone. The theory is a simple one—so simple that any one can readily understand it. Briefly put, it amounts to this: Worry injures beyond repair certain cells of the brain; and the brain being the nutritive center of the body, the other organs become gradually injured, and when some disease of these organs, or a combination of them, arises, death finally ensues. Thus does worry kill. Insidiously, like many other diseases, it creeps upon the brain in the form of a single, constant, never lost idea; and, as the dropping of water over a period of years will wear a groove in a stone, so does worry gradually, imperceptibly, but no less surely, destroy the brain cells that lead all the rest—that are, so to speak, the commanding officers of mental power, health and motion.

Worry, to make the theory still stronger, is an irritant at certain points, which produces little harm if it comes at intervals or irregularly. Occasional worrying of the system the brain can cope with, but the iteration and reiteration of one idea of a disquieting sort the cells of the brain are not proof against. It is as if the skull were laid bare and the surface of the brain struck lightly with a hammer every few seconds, with mechanical precision, with never a sign of a let-up or the failure of a stroke. Just in this way does the annoying idea, the maddening thought that will not be done away with, strike or fall upon certain nerve cells, never ceasing, and week by week diminishing the vitality of these delicate organisms, so minute that they can only be seen under the microscope.

To Rid Caoutchouc Articles of their Disagreeable Odor.—Most caoutchouc ware has a highly unpleasant odor, which is also imparted to other goods, for which reason such articles cannot be used for many purposes. According to S. Bourne, this smell will entirely disappear, if the articles are covered on both sides with a thin layer of animal charcoal and then heated with the charcoal for 3 to 4 hours from 50° to 60° C.

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APPARATUS FOR DETECTING WITH THE AID OF CROOKES TUBES THE LOCATION OF FOREIGN BODIES.

NEW SYSTEM FOR LOCATING BULLETS.

THE surgeons were the first to comprehend the practical importance of the discovery of the X rays. But a few days elapsed after the never-to-be-forgotten communication by Prof. Roentgen before the hospitals of Paris were using the "radiograph" or the "radioscope" for locating foreign substances introduced into the bones or tissues of human bodies.

But the surgeons were not long in discovering the fact that it was imprudent to exact too much from these rays. They did not always indicate the precise location of these foreign substances, and the operator sometimes risked the patient's life by depending too completely on the insufficient indication given by the X rays.

It was ascertained without a doubt that the radiograph, even with the aid of clinic signs, was manifestly impotent—this fact has been proved by repeated experiments—to positively locate a ball which had been fired into the brain by a murderer's or suicide's hand.

FINDING THE DIRECTION OF THE BALL WITH THE COMPASS.

Was it possible that this collaboration with the X rays, from which so much had been hoped, would prove a failure? Surgeons had been forced to this conclusion much against their will, when, fortunately, a young man, M. Contremoulins, of the Laboratory of Micro-Photography, under the direction of M. Remy, member of the Faculty of Medicine, in Paris, came to the fore and quieted the fears of scientists and surgeons by inventing an apparatus called "le chercheur de projectiles," or "searcher for projectiles," which he claims is capable of revealing with the absolute precision of a "demi-millimeter" the exact location of a ball in the brain.

This apparatus, which only left the hands of its inventor a few days ago, has a history connected with it which is worth relating. Its invention not only does honor to the knowledge and tenacity of MM. Contremoulins and Remy, but it also proves that there are still some persons in France interested enough in scientific research to encourage them and to help financially when such assistance has been denied by the state.

The Faculty of Medicine in Paris was not in possession of the necessary funds for starting and maintaining a radiograph laboratory, and yet such a laboratory exists and owes its existence to MM. Contremoulins and Remy. The former, fascinated by Roentgen's discovery, and foreseeing its innumerable applications to surgery, procured, at his own expense, with the assistance of M. Remy, the indispensable apparatus for such a laboratory.

He constructed at his own expense an apparatus still embryonic, but which, however, indicated and discovered with a perfect precision any projectile introduced into a brain.

This experiment, first satisfactorily performed some six months ago, was most eulogistically spoken of by Prof. Marey, in a lecture at the Academy of Medicine.

It now became a question of constructing the apparatus of which M. Contremoulins had made the model. This called for an outlay of 2,500 francs. This amount not forthcoming, the construction of this useful apparatus would be retarded and even prevented. M. Marey made this "sad revelation," as he called it, publicly, expressing the hope that in showing the penury to which science was reduced some generous patron might be induced to come foward and donate the necessary sum.

This appeal was inserted in Le Temps, and the next day a M. Dessaux sent the necessary 2,500 francs to M. Marey. M. Contremoulins was then in a position to push the work ahead on his apparatus, which was delivered to him in its perfected state the first of last month.

M. Contremoulins' "searcher for projectiles" has made good its promises. It has already searched for and found the balls which two unfortunates had lodged in their brains. The operation of extracting them was performed recently by M. Remy in a remarkably skillful manner. The patients, who have recovered very rapidly, left the hospital the past week. The success of the operation was proclaimed amid great applause on Monday, December 6, at the Academy of Sciences, and on Tuesday, December 7, at the Academy of Medicine.

The principle of the method is as follows: With the aid of two radiographic proofs, obtained at different times, of a head, inside of which is seen a ball, the center of this ball is determined by a geometrical construction, and by its relation to three fixed points or guiding marks traced on the face of the wounded man.

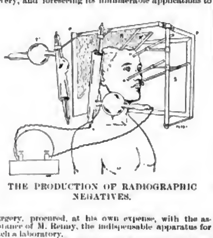
Then, by means of small movable arms jutting outward, the ends of which come together, the relative position of the three fixed points and the ball are determined. The four extremities of these movable arms are then attached to a compass. This compass, thus set, is placed upon the head of the patient and adjusted to the three guide marks on the patient's face; the extremities of the fourth arm, if the head has been perforated, will coincide exactly with the center of the ball. It is then only necessary for the purpose of extraction to follow the direction indicated by the fourth arm and to penetrate to the depth indicated by the length of this arm.

To obtain two radiographic proofs which will permit of the exact locating of the center of the ball calls for the absolute immobility of the Crookes tubes in connection with the sensitive plates. With this end in view, two small, thin pieces of wood are sealed in plaster and placed on the upper part of the patient's head, and to these is screwed a metal plate.

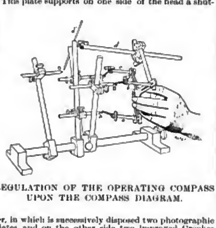
This plate supports on one side of the head a shutter, in which is successively disposed two photographic plates, and on the other side two improved Crookes tubes, joined in such a manner as to allow them to be moved to any desired position.

Besides, this metal plate has on its outer surface three jointed arms, whose extremities are placed on the three guide marks on the patient's face; these marks are, generally, one on the forehead and two on the cheeks. This primary apparatus being thus disposed (and called the "searching apparatus"), a photographic plate is slid into the shutter, and is worked by sending a current from a very powerful Ruhmkorff coil, giving a thirty-eight centimeter spark through one of the Crookes tubes.

At the end of a quarter of an hour a radiograph is obtained. After this plate is developed, the shadow of the ball will be distinctly seen in the interior of the brain. The operation is renewed by means of a second plate and a second Crookes tube. In this way two pictures of the same ball are obtained, occupying different positions, for the reason that the luminous focus of the two Crookes tubes occupies different positions in relation to the ball and the shutter inclosing the plates.



THE PRODUCTION OF RADIOGRAPHIC NEGATIVES.



REGULATION OF THE OPERATING COMPASS UPON THE COMPASS DIAGRAM.

The metal plate is then removed from the patient's head without disturbing the different parts of the apparatus. If we now prolong the focus of each of the Crookes tubes and the center of the shadow of the ball on the corresponding radiographic plates by means of threads, we reconstruct the path of the luminous rays. The point at which these threads cross is the point at which the luminous rays had but a moment before met. This, then, is the center of the ball, and the point at which the threads intersect each other gives the exact position of the ball in the brain at the moment the radiograph was taken. This apparatus M. Contremoulins calls "the compass schema," and by it regulates the compass of operation.

The obtaining of the radiographic negatives that permit of determining the center of the ball necessitates an absolute immobility of the Crookes tube with respect to the sensitized plates. To this effect, two pieces of wood, R R, to which is screwed a metallic frame, P, are fixed to the head of the patient with plaster. This frame, on one side of the head, supports a frame in which are successively arranged two photographic plates, S, and, on the other side, two improved Crookes tubes, T and T', so jointed as to permit of giving every position necessary. Besides the frame, P, carries at the front part three jointed rods, the extremities of which are applied to three points of the patient's face, which are usually selected as follows: One upon the forehead, M, and the two others upon the cheek bones, N O.

This first apparatus, called the "research apparatus," being thus arranged, a photographic plate is placed in the frame, and one of the Crookes tubes, T, is actuated by passing through it a current from a very powerful Ruhmkorff coil, giving a 38 cm. spark. At the end of a quarter of an hour the radiograph is obtained. Then the plate is developed, and the image of the projectile is seen detaching itself from the interior of the image of the skull. The operation is renewed with a second plate and the second Crookes tube. There are thus obtained two images in which the projectile does not occupy the same place, since the luminous foci of the two Crookes tubes occupied different positions with respect to the ball and to the frame inclosing the plates.

The frame, P, is removed without touching the different parts of the apparatus. If we connect by wires the focus of each of the Crookes tubes with the center of the image of the ball upon the corresponding radiographic negative, we shall reconstruct the passage of the luminous rays. The point at which these wires cross each other is the one at which the luminous rays were just met with. It is therefore the center of the ball; and the point of intersection of the wires gives the position that the projectile occupied in the skull at the moment at which it was radiographed. The three rods, whose extremities, M N O, correspond to the three register marks of the face, remaining in place, the crossing point of the wires gives the position of the center of the ball with respect to the three register marks. The whole of this permits of the construction of a diagram practically fixing the relative positions of the projectile and the three register marks.

Near the apparatus above described is placed a small platform on which slide four columns carrying four jointed rods. It suffices to bring the extremities of these rods in contact with the crossing point of the wires and the register points, M N O, in order to transfer to D the center of the ball and to A B C the register points, in their relative positions. This is what M. Contremoulins calls the compass diagram.

Henceforward the primitive apparatus will be useless. The diagram will advantageously replace it, since it is possible to pack it and carry it to a hospital or to the home of the patient.

The "compass operation" is, properly speaking, the true "projectile seeker." This compass consists of four branches, three of which, a b c, are so fixed and arranged as to apply themselves by their extremity to the points, A B C, of the compass diagram, which correspond to the register points of the patient's face. The fourth branch, d, which is movable in all directions, carries a guide through which slides a blunt needle, d'. This branch is fixed in the proper position and the needle is made to slide until it comes into contact with the point, D, of the rod of the compass diagram representing the center of the projectile; and by means of a screw ring one fixes upon the needle the point at which it stops in the guide when its extremity is in contact with the point, D.

The operating compass is regulated, and all that remains to be done is to transfer it to the patient in order that the surgeon, guided by the needle, may begin his work. In order to effect this transfer, the blunt needle is removed from its guide. As shown in the figure, the extremities of the three branches, a, b, c, are applied to the three register marks tattooed in the patient's skin. Then it suffices to slide the needle in its guide in order to obtain a precise indication of the direction in which the ball is to be found. The depth is indicated by the distance between the guide and the ring screwed upon the needle.

As the branch, d, may be placed in any position at will, it suffices to regulate the compass differently in order to obtain a different direction of the needle. Thus the least perilous, surest and shortest way may be chosen. Whatever be the way selected, the needle will always indicate the exact direction and depth of the projectile. In the course of the operation, the needle will constantly indicate, through the distance of the ring in the slide, the precise distance at which the operator is from the projectile. Finally, when the ring is in contact with the slide, the projectile will be under the surgeon's instrument. If, instead of one ball, it is necessary to extract several, or several fragments, the method may be applied with the same sureness.

For our engravings we are indebted to L'Illustration.

To Make Labels Adhere on Tin.—Labels will adhere perfectly to tin, no matter what paste is used, if you wipe the entire surface of the tin with merely a suspicion of hydrochloric acid. The reason is that all tin is dressed in oil, and hydrochloric acid removes that, just as it does for the solderer.

PINEAPPLE FIBER.

INDICATIONS are that the fiber of the pineapple leaf will eventually take prominent place among the constituents of textile fabrics.

Both the wild and cultivated pineapple yield fiber which, when spun, surpasses in strength, fineness and luster those obtained from flax; can be employed as a substitute for silk, and as a material for mixing with wool or cotton. Useful for cordage, textile fabrics, sewing silk or twist, laces, etc. In China, fabrics for clothing for agriculturists. In request in India as material for stringing necklaces. Produces the celebrated pina cloth of the Philippine Islands. It is remarkably durable, and unaffected by immersion in water; and is white, soft, silky, flexible, and long in staple. Samples cleaned, without washing, in the government experiments in Florida, 1892, when twisted to the size of binding twine, showed a breaking strain of 150 pounds. Dr. Taylor subdivided a specimen of this fiber to one ten-thousandth of an inch.

Pineapple culture, for its fruit, in Florida, is a comparatively recent industry, the first plantings having been made on the keys about 1886, though the first plantation of commercial importance was not established until five years later, on the Indian River. The value of the fiber has long been known, however, and in 1891 the fiber expert of the United States Department of Agriculture began a series of investigations into the practicability of utilizing the Florida leaves for fiber after the fruit had been gathered, as their utilization would give to the United States a new industry. In the experiments of 1892 it was shown that the yield of fiber from freshly cut pineapple leaves ranges from 45 to 60 pounds per ton of 2,240 pounds of leaves. An important point to be noted is the fact that selected leaves as to size do not give as high a yield of fiber as average leaves. Lot No. 1 was 820 pounds of average and 202 pounds of leaves. While the total, 1,022 pounds of leaves, gave 25 pounds of fiber, against a yield of four pounds from 202 pounds of selected leaves. Reduced to equivalents, the average leaves yielded at the rate of 57½ pounds to the ton, while the selected leaves yielded less than 44¾ pounds of fiber to the ton.

Lot No. 5 was from Fuzzard's plantation, near the Perrine grant, 1,000 pounds of leaves, tips cut off. The leaves averaged 10 to the pound. Dry fiber from this 1,000 pounds weighed 18 pounds 2 ounces, or a little over 40 pounds to the ton of leaves. It should also be noted that there was an excessive waste of fiber in the process of cleaning.

Special Agent Monroe, who attended to the details of the experimental work of 1892 in Florida, stated that the practice has been to allow the leaves to decay under the plant and afford possible nourishment to the young suckers. The general opinion on this point is in favor of cutting the leaves, but experiments covering several seasons will be necessary to decide this point. Owing to the practice on the keys of planting very close, it was found that a large proportion of the leaves were injured by chafing one on another, and also from being crushed under foot in weeding and cutting the fruit. This condition seems to be almost entirely obviated by spacing the plants at least two feet, as has been done on the mainland. Another defect was found in the withered condition of several inches of the tip or end, not noticeable in the younger leaves. This, however, may have been due to the excessive drought of the season. It does not occasion much loss of fiber, but adds to the cost of extraction, the decayed parts having to be cut off. The approximate acreage in pineapples in 1892 on keys Metacumba, Largo and Elliott's was 930, and the number of apples shipped (1892) about 1,016,000, which did not include many thousands marketed after the close of the season.

The average yield of good leaves from the Red Spanish was about 10 out of the average 25 of each plant, and the weight one pound, making the total for fruited plants, in round numbers, 938 tons. Adding the leaves to be secured after the close of the season and from abandoned fields, the quantity might be raised to 1,000 or 1,100 tons. This refers, of course, to extreme southern Florida, no account having been taken of the large acreage on Indian River and elsewhere.

As to the value of the fiber, a London quotation for a lot of well cleaned from an Asiatic source was $150 per ton. There is no doubt that if the fiber could be produced in quantity at an economical cost, manufacturers would soon find a use for it and would know what price they could afford to pay for it. The market price would then be fixed by the demand and supply. The machine question enters largely into the problem, however, and as the leaves are small, a quantity would need to be cleaned at one feeding of the machine to make it pay. Estimating ten leaves to the pound, there would be over 22,000 leaves to the ton, which, as we have seen, would produce from 50 to 60 pounds of fiber.

The machine used in the department experiments produced a fine product, but in too small quantity to be employed commercially. There is no doubt that a modified Sisal hemp machine (automatic) would do the work, although a machine has recently been constructed for a small leaved plant that may be adopted to use in extracting the fiber.

The Chinese extract the fiber by hand. The first step is the removal of the fleshy sides of the leaf. A man sitting astride a narrow stool extends on it in front of him a single leaf, one end of which is held beneath him. He then, with a kind of two handled bamboo plane, removes the succulent matter. Another man receives the leaves as they are planed, and with his thumb nail loosens the fibers about the middle of the le... gat...ers them in his hand, and by one effort deta... from the outer skin. The fibers are next ... washed and laid out to dry and hie... frames of split bamboo. The proces... washing and exposing to the sun are r... the fibers are considered properly ble... Philippines the blunt end of a pot... sl... the fiber is carefully combed and s... classes.

...e fiber is manufactured into a strong, ... resembling the coarser kinds of grass ... Formosa its chief use is for the inner gar... the agricultural class. The fabric is called Huang-li-Pu. Pina is considered to be more delicate in texture than any other known to the vegetable kingdom. It is woven from the untwisted fibers of the pineapple leaf after reducing them to extreme fineness and after the ends have been glued together to form a continuous thread. There is another delicate fabric, used for ladies' dresses, which is said to be manufactured from pineapple fiber woven with silk, the latter forming lustrous stripes in soft colors or shades.

The pineapple cloth of the Philippines is produced by the common pineapple also, i. e., Ananas sativa. The plants have become almost wild in Singapore and the Philippines, with leaves five to six feet long. The fruit is small, but the leaves appear to yield better fiber than the cultivated plants.—From Catalogue of Useful Fiber Plants of the World, by United States Department of Agriculture.

REPEATING BELLS IN CLOCKS.

IT may prove interesting and useful at a given moment to have the striking train of a clock repeat the hour at one's will. We shall describe a simple arrangement devised to this effect by M. F. Derry. This system, which possesses no complicated mechanism, may be applied to any kind of a clock and be actuated at a distance by means of a pneumatic or electric button.

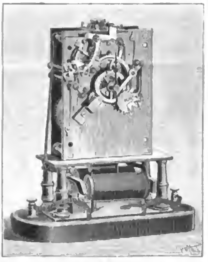


FIG. 1.—A REPEATING CLOCK.

Let us in the first place give a brief description of the classic system of starting gear of a rack train that strikes the hours and half hours. At rest, the different parts are in the position shown in the diagram (Fig. 2), and the wheelwork is arrested by a snug fixed to the piece, H. Upon the piece, A, are fixed two pins, A' and A'', which are so arranged that after lifting the detent, G, the latter may drop just at the moment at which the hour hand is upon 12 or 6. As soon as it is raised, the detent, G, carries along with it the stop, H. At this moment there occurs the first start of the wheelwork, which is almost immediately arrested by a

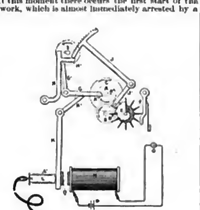


FIG. 2.—DIAGRAM EXPLANATORY OF THE STARTING ARRANGEMENT OF A STRIKING TRAIN.

snug fixed to the detent, G. The object of such start is to render the wheelwork dependent upon the detent, the wheelwork not being set free until the moment at which the detent falls. The pieces, G H, continuing to rise (carried along by the pin, A), the rack, J, soon becomes free, and, actuated by a spring, falls until its arm, J', abuts against the snail, E, leaving beneath the arm, H', a number of teeth exactly corresponding to the indication of the hour given by the small hand.

The snail, E, and the star wheel, D, are interdependent, and the latter, being every hour carried along by the pin, B, advances one tooth and thus permits the rack, J, to make a longer travel in measure as 12 o'clock is approached. The pieces remain in the position just indicated until, the long hand having reached 12, the detent, G, falls and sets the wheelwork free. The piece, H, remains raised (the arm, H', engaging with the teeth of the rack) and permits the wheelwork to continue its revolution. The rack is raised tooth by tooth by the click, I, fixed upon the second wheel. To every revolution of the latter there corresponds one blow struck upon the bell of the clock. As soon as the rack is lifted high enough, the piece, H, falls to its position of arrest in stopping the wheelwork. In order to cause one stroke only to be given at the half hour, the pin, A', is fixed upon a smaller diameter, so as to raise the pieces, G and H, sufficiently to permit of the first start, but not enough to cause the rack to fall. The wheelwork is therefore arrested as soon as the second wheel has made one revolution.

In order to cause the clock to strike at every quarter, the principle is the same as for the hours.

From what precedes it will be seen that in order to free the striking train, it is necessary to raise the piece, H, sufficiently to permit the rack, J, to fall. This is effected by M. Derry's arrangement in a very simple manner. K is a lever, of which the upper arm, K, engages with the detent, G, the lower arm serving for the maneuvering. If the lower arm be provided with an armature, Q, the latter will be attracted by the electromagnet, N, as soon as the circuit of the battery, P, is closed at any point whatever by means of a temporary contact.

The result will be the same if, instead of the electric system, the pneumatic be employed. The arrangement in this case is of still greater simplicity, because it necessitates no installation, either of a battery or of wiring for leading a current from a distributing line.

Two tubes, L and L', one entering the other, are closed at their extremities. One of these tubes is stationary and receives the extremity of a small rubber tube of sufficient length to answer the requirements that one has in view. The other tube is movable and abuts against the lower arm of the lever. Upon squeezing a bulb fixed to the free extremity of the rubber tube a pressure of air will be brought about in the tube, L, sufficient to act upon the tube, L', and, at the same time, upon the lever, K.

Fig. 1 represents what is called a traveling clock, the case and dial of which have been removed.

For the sake of demonstration, both the electric and pneumatic systems above described have been applied to this clock, which repeats the hour at every quarter.—La Nature.

TESTING A BOILER TO DESTRUCTION.

AT the recent convention of the American Boiler Manufacturers' Association, held in Philadelphia, John O'Brien described, says the Mining and Scientific Press, the testing of a boiler to destruction. The boiler was made and the tests were instituted and carried through by the O'Brien Company. The boiler was 60 inches in diameter by 12 feet in length. The shell was ⅜ inch steel of 60,000 pounds tensile strength. The heads were of ½-inch steel. There were fifty six 3½-inch tubes. The front head was braced with five ⅝ by 4 inch flat stays, doubled. The boiler was made of two rings, designated A and B. The joint of ring A was a butt joint with inside and outside straps. The joint of B was a triple rivet lap joint, with an inside strap extending 2½ inches each side of the ends of lapped plates. The circular seams were single riveted.

The results of the tests, in which hydraulic pressure was employed, are indicated by the following record:

TEST NO. 1.—MARCH 29, 1897.

Ring B.

	Inches.
At 300 pounds pressure ring expanded	1⅝
" 450 " " " "	2⅝
" 750 " " " "	3⅛

Ring A.

At 300 pounds pressure ring expanded	2⅝
" 450 " " " "	3½
" 750 " " " "	5

TEST NO. 2.—APRIL 4, 1897.

Ring B.

At 625 pounds pressure ring expanded	3⅜
Increase in expansion over test No. 1	⅝

Ring A.

At 625 pounds pressure ring expanded	5¼
Increase in expansion over test No. 1	¼

TEST NO. 3.—APRIL 5, 1897.

Ring B.

At 350 pounds pressure ring expanded	4 1/16
" 400 " " " "	4 1/16
" 625 " " " "	4 7/16
Increase in expansion over test No. 2	1/16
Total expansion for the three tests	4 7/16

Ring A.

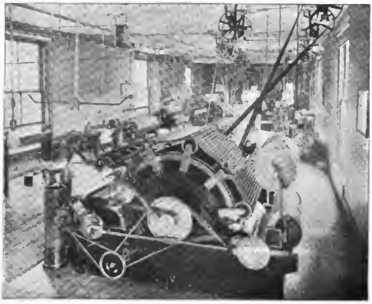
At 350 pounds pressure ring expanded	5⅜
" 400 " " " "	5½
After 400 pounds pressure no perceptible change occurred.	
Increase in expansion over test No. 2	⅛
Total expansion for the three tests	5½

At 900 pounds pressure the boiler ruptured on the side, horizontally in the second ring about 18 inches above the riveted joint, in the whole plate, the rupture being about a foot long.

The putting of new wine into old bottles is by no means an uncommon occurrence in these degenerate days, says the Pottery Gazette. An ingenious inventor, however, has devised a bottle which cannot be refilled without detection. It has a visible compartment, in which is placed blotting paper or some other substance which will be defaced by wetting, and is so constructed that, in pouring into it, some of the liquid must enter the compartment.

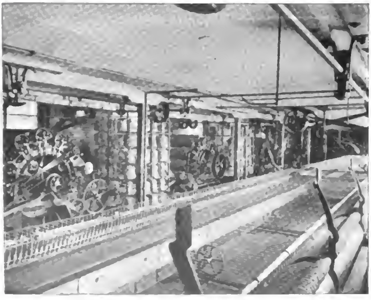
PHILADELPHIA TEXTILE SCHOOL.

WE take pleasure in publishing in the present issue a few views of the Philadelphia Textile School, an institution which is destined to exercise a powerful influence in the development of American manufactures. The question of technical education has come to be regarded as of the very first importance in the industries of this country, and it may be safely stated that on nothing else does their future welfare depend quite as directly as on the promotion of such good work as that of which the Philadelphia Textile School is the leader in America. The eagerness with which the establishment of similar schools is discussed throughout the South and the recent establishment of a school in Massachusetts furnish sufficient proof of the fact that this principle is now recognized, and the work of educational organization and adjustment which it implies is sure to go rapidly forward after this.



A VIEW IN THE COTTON CARDING AND SPINNING ROOM OF THE PHILADELPHIA TEXTILE SCHOOL.

ONE OF THE POWER WEAVE ROOMS.



THE WOOL CARDING AND SPINNING ROOM.

The school, which is a part of the Pennsylvania Museum and School of Industrial Art, is simply the embodiment of the idea that technical education, to be effective, must be definite and practical in its relation to the industries which it is intended to affect. It is not a school for the teaching of the general principles of mechanics or of anything else. Its laboratories are practical workshops, or rather mills, in which the greatest variety of production is carried on, and may be studied and practiced almost as well as in establishments devoted to any one line of manufacture and managed on a commercial basis. It is well known that while there are excellent schools of this kind in Europe, there are very few in America. We have illustrated the Lowell Textile School in the SCIENTIFIC AMERICAN for October 16, 1897. For example, the very excellent school at Crefeld, which is always pointed to as probably the best school of its kind in Europe, while well equipped for the study of silk, is by no means fitted to teach the principles that relate to cotton manufacture. The school in Manchester, England, has excellent facilities for teaching the manipulation of cotton, but is meagerly provided with either appliances or courses for the instruction of whatever relates to wool or silk.

The Philadelphia Textile School, enjoying as it does the advantage of being located in a city whose textile industries are not only enormously developed, but immensely varied, and having students interested in the greatest variety of work, has the opportunity of illustrating its teaching outside of the class room by means of visits to the industrial establishments of almost every conceivable form of textile manufacture in the neighborhood. The managers of the institution have always aimed to make the most of these advantages, and alike in the selection of the equipment and of the instructors, they have aimed to give the utmost possible breadth to its work.

The school is magnificently housed in buildings that stretch the entire length of a Philadelphia square in the very heart of the city, and is furnished with every kind of material which is requisite to the treatment of fibers, from the raw material to the finished fabric; including chemical laboratories, a dye house, carding and spinning rooms for wool and cotton, as well as appliances for the reeling of silk, etc.

The corner stone of its system, so far as the methods of instruction are concerned, is insistence upon the thoroughness with which each student is expected to perform the practical work instead of having all the hard work done for him, as is almost universally the case in European schools of a similar character. This is a thing which is at once recognized and commented upon by visitors and students who have attended the schools in Europe, of which there have been a great many registered in the Philadelphia Textile School. They unhesitatingly testify to the superiority of the American method and bear testimony to the fact that it is in the main a great mistake to send boys to Europe for an education of which they are expected to apply the results in America.

In the Philadelphia school every boy is expected to dye his own yarn, make his own warp, punch his own cards, and weave his own goods, and for this purpose a loom is assigned to him and he alone is responsible for what it contains and what it produces. This is probably not the case in any school in Europe, or any other in America, where mechanical appliances are for the most part used more for demonstration of principles and theories than as a means of manual as well as mental development. The importance of this principle is hardly to be overestimated; if the new idea in education means anything, it means that the pupil learns by doing. Laboratory methods are not merely demonstrations. If they were, the lecturer with a perfectly equipped desk between him and his pupils would furnish the ideal of teaching. The Philadelphia school carries the laboratory idea further than any institution in our midst, and the boys actually do the work, thereby being educated and developed. Not the least important thing that is to be said about this new education is that it has caused a class of men to take a deep interest in educational matters who used to think very little about them. Delegation after delegation of business men have visited the Philadelphia Textile School and have borne testimony to the importance of the work in which it is engaged.

The New England Cotton Manufacturers' Association, a body which had never held a meeting outside of New England, with the exception of the one held during the Atlanta Exposition, held its last convention in Philadelphia, in order that its members might inspect the work of the Philadelphia Textile School.

The National Association of Manufacturers also held its annual convention in Philadelphia in June, 1897, and devoted a portion of its time to the inspection of the school, when President McKinley visited the school and spoke in the highest terms of the work which it was doing and the important influence which it was sure to exercise on the industrial development of the country.

The interest manifested by the National Association of Manufacturers is of exceptional importance from the fact that the present president, Mr. Theodore C. Search, is the man to whom the school really owes its creation. Early in the eighties, Mr. Search, through his own initiative, and with only a meager support, established the school in the conviction that it was the one thing necessary for American textile progress, and almost unaided for many years he carried on the noble work of building up the institution which enjoys so great a reputation to-day.

FIRST PEANUT OIL FACTORY IN THE UNITED STATES.

THE first peanut oil factory in the United States will be established in Norfolk, Va., at an early date. The oil is highly valued in Europe, as it is stated that fully \$3,000,000 worth of peanuts are taken into Marseilles annually for the manufacture of oil, which is used in

toilet soaps and for other purposes. The peanut flour is quite extensively used in Europe and made into bread, cakes, biscuits, etc. It is one of the favorite articles of food, according to consular reports, in hospitals in Germany. The capital stock of the peanut company is $00,000, and it will operate under the patents of Mr. Weatherly, which cover the machinery and methods of decorticating the kernel of the inner skin. According to the estimates made, says the Atlanta Constitution, the cost of a plant for treating five tons of peanuts daily is as follows: Machinery, $0,000; building, $0,000; while the expenditures, including labor, insurance and taxes, amount to $857 per day. In a prospectus issued by the company, it is calculated that the receipts from five tons of peanuts will amount to 285 gallons of refined oil at $1 per gallon, 175 gallons of crude oil at 50 cents, 3,680 pounds of flour and meal at 2 cents and 3,680 pounds of stock feed at 60 cents per 100 pounds, making the total gross receipts $415.90 per day, which, it is estimated, would give a yearly profit on a five ton factory of $19,735.—National Provisioner.

ENLARGEMENT OF THE PORT OF MARSEILLES.

A DECREE of July 17, 1893, declared of public utility the work to be executed for the enlargement of the port of Marseilles through the construction of a new basin to the north of what is called the National. As this maritime work has just been begun, we think that we shall interest our readers in making known to them the reasons that prompted it and the conditions under which it is proceeding.

Despite the great injury to the exterior commerce of France caused by the successive increases in customs duties, the increase of navigation in the port of Marseilles rendered a new extension of the basins necessary. In fact, while in 1878 the total figure of the tonnage gage of the vessels that entered and cleared was 5,400,000, it rose in 1889 to 9,518,300, and in 1891 to 10,611,000, with a drop to 9,453,000 in 1893, followed in 1896 by a rise of 10,548,000 tons divided among 16,290 ships.

Unfortunately, it must be considered that such increase is due especially to foreign flags and that it is very slight as compared with the progression followed by the large competing ports.

On comparing the effective movement per linear foot of wharf (that is to say, the quotient of the tonnage gage by the utilizable length of the wharves) with the figure of 300 tons considered as the limit beyond which maritime commerce ceases to have the facilities of which there is need, we clearly recognize the inadequacy of the present installations of the port of Marseilles, since the normal coefficient was doubled in 1896. The wharves that are particularly needed are such as may be accessible to ships of heavy draught.

There is no wharf that can receive vessels drawing more than 25 feet of water, and these have to operate in the middle of the basins. As the Suez Canal has been deepened to 28 feet, it became urgent to provide for the landing of vessels of such load water line at wharves. The work of deepening the National Basins along the wharves of its two inner moles is now in progress.

The creation of a new basin was further prompted by the removal toward the north of the New Abattoir ... which it appeared expedient ... landing of cattle, of which ... Finally, a special ... petroleum has long ... utmost necessity, in order to prevent ... fire in the port and to isolate the ... entrance to which will be closed by ... vel of the sea.

The arrangement of the places ... made up to the present to the extension of ... illes toward the north and also the pros... of the junction canal with the Rho... ated the general plan of the new basin, con... olonging the jetty (which is already 2½ ... gth) in a straight line to abreast of Cape ... in constructing the new maritime ... etween it and the shore. The new basin, called the "Pinède," after the name of the cape in front of which it will extend, will measure 2,100 feet in length by 1,640 in width. It will be divided into three secondary basins by two moles and be bounded on the north by the mole of Madrague, situated in front of the village of that name, which has become a faubourg of Marseilles.

The Pinède basin will increase the length of the utilizable wharves in the interior of the port by 9,050 feet, a length which now reaches the total figure of 43,285 feet for a surface of water of about 1,300,000 square yards. The depth at the foot of the new wharves will be everywhere 28 feet. Moreover, the alignment of the shore wharf prolonged beyond the petroleum yard as far as to Cape Janet will unite in Madrague Bay a surface of about 120,000 square yards, which will form an excellent docking for the numerous ships, lighters, etc., that encumber the different basins.

The plans (Figs. 2 and 3) of the port of Marseilles and of the new basin that is to be opened to the north will permit of obtaining an accurate idea of the work that is now in progress. All the plans and specifications having been definitely drawn and the arrangements made by the maritime engineering service, which is under the direction of M. Guerard, the work was begun and then suspended and last year was made the object of a new adjudication, comprising the construction of wharf walls and the deepening of the basin. Out of the four houses that put in bids, that of Zschokke, of Switzerland, which has done much work in France, obtained the contract at five million francs, the work to be completed in five years.

At the beginning of June last, work was begun in front of Cape Pinède by the construction of a wharf wall, which will form the north side of mole E.

Two large compressed air caissons of an improved type were submerged. In each of these 20 laborers work at a time, at a depth which is 20 feet at present, but which will be increased later on, since the walls of the batterdeaus will have to be founded at 40 feet below low tide. Four other caissons will successively be put in service in measure as they are needed.

The arrangement and installation of one of these caissons present considerable interest and are worthy of description. The caisson consists of a large rectangular iron plate box 65 feet in length, 21 feet in width and 9 feet in height. There is no floor, but, on the contrary, the ceiling, which is situated at a height of 6 feet, is of double thickness and strengthened by very strong iron girders. The walls of this huge caisson rest through their sharp edge upon the rocks of the uneven bottom of the sea, and the working chamber has a capacity of 2,800 cubic meters.

The caisson is kept perfectly tight by means of compressed air. The high pressure of the air prevents the ingress of water from below, and on another hand, the ballast deposited upon the top and kept in place by the rim of the caisson prevents the latter from rising.

Communication between the exterior and the interior of the caisson is assured by three cylinders wider than the diameter of the human body and of variable height and that emerge above the level of the sea, where each terminates in an air lock. One of these locks serves for the workmen and the two others for the materials. It is through the lock provided for them that the laborers enter and make their exit by means of a double door which allows of access to the cylinder, in which there is a small iron ladder that leads to the working chamber. The locks are lighted, and those for materials, which are provided with windlasses, have automatic doors. Access to them is had by means of lighters. The section of one of these caissons that we give in Fig. 1 very well shows the general plan.

The machinery of the working station, installed in the open air upon a terrace in the vicinity, produces, with 80 h. p., the compressed air necessary, as well as the electricity that supplies the ten incandescent lamps of each submerged working chamber. Two gangs of laborers continually replace one another in the caissons in order that the excavating and the laying of the masonry may never be interrupted, day or night.

Finally, when it becomes necessary to change the location of a caisson, lighters lashed together and provided with towing apparatus make fast to it and move it to its new position.

It will be seen that this is an important work that is to be accomplished in the port of Marseilles. According to the law of 1893, the total cost is estimated at twenty million francs, a third of which is furnished by the Chamber of Commerce, while the remainder will have to be provided for in the annual budgets of the Minister of Public Works. In order to assure the service of the loan that the contribution of the Chamber of Commerce has exacted, a toll of five centimes per ton is collected at the entrance upon merchandise coming by sea, as well as upon the heads of cattle.

It must not be supposed that the government shows a particular generosity toward the first port of France. In fact, from 1811 to 1892, while eighty-eight million francs were spent for Havre and forty-two for Dunkirk out of the funds of the treasury, only seventy-six millions have been appropriated for Marseilles. And yet the annual amount of custom duties collected at this port alone reaches nearly this figure. —La Nature.

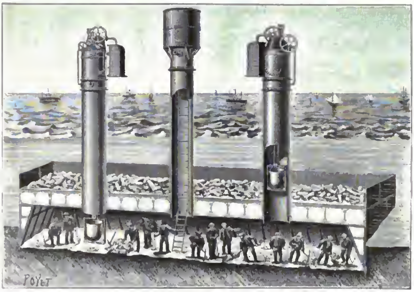


FIG. 1.—SECTION OF ONE OF THE CAISSONS USED IN THE WORK OF ENLARGING THE PORT OF MARSEILLES.

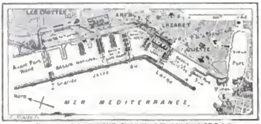


FIG. 2.—PRESENT PORT OF MARSEILLES.

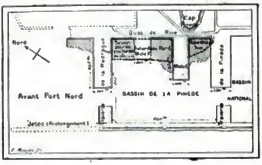


FIG. 3.—NEW BASIN OF MARSEILLES.

THE COMPARATIVE ADVANTAGES AND DISADVANTAGES OF STEAM, COMPRESSED AIR AND ELECTRICITY FOR POWER PURPOSES IN COAL WORKING, WITH SPECIAL REFERENCE TO COAL CUTTING AND HAULAGE.

(The Iron and Coal Trades Review Prize Essay.)

By G. E. J. MCMURTRIE, A.M. Inst. C.E., Cinderford.

IN considering the comparative advantages and disadvantages of steam, compressed air and electricity for power purposes, with special reference to coal cutting and haulage, the writer is much struck by the careful manner in which the efficiency of most, if not all, recent important electric installations has been tested. The same remark may be applied to the more recent extensions of the use of compressed air at Paris and Birmingham; whether the efficiencies of the large air compressing plants still being put down at collieries, especially in South Wales, are noted with equal care, is probably open to question.

Mr. Nicholas Wood found, as the result of experiments, that, where no special source of loss existed, underground hauling engines can realize an efficient performance of 40 to 50 per cent. of the pressure of the steam upon the piston, and with the improved engines of the present day the value may be safely increased to 50 to 60 per cent. (estimated) in coal conveyed. Few recent records can be found of steam haulage plants, although doubtless many are still being put down.

The efficiency of such a plant is seldom recorded. If taken, the actual cost of haulage is given in cost per ton per mile, the principal costs being grouped under the heads of ropes or chains, maintaining plant, coal and labor. The first cost comprises that of wagon way, plant and original cost of boilers, engines, etc., the comparative first cost per mile of wagon way being thus obtained.

The writer would have expected that those in favor of the older systems of steam and compressed air haulage, in the face of the keen competition of electricity, would have gone to considerable trouble to put forward confuting figures; yet, when this question has been brought before mining institutes, general statements alone have been produced on their behalf, and exact figures, which have been almost ostentatiously displayed by the advocates of their powerful rival, have been withheld.

This has greatly added to the writer's difficulties, as, whatever may have been his predilections, actual records of hard facts can alone carry weight and be considered.

The principal purposes for which power will be required at collieries are winding, hauling, pumping and coal cutting, and hitherto steam alone has been

used in this country for the first purpose, although a large winding plant of 300 horse power has, the author understands, been dispatched to and erected at the De Beers mines in South Africa, and is in successful work.

Possibly, too, instances could be found of small installations in England for raising material from shallow staple pits.

But here the record of electric winding has ended, although able papers have been written advocating the entire use of electricity as the motive power of a colliery largely on account of the greater efficiency that would be obtained from one central plant, instead of, as now, a number of scattered plants, with steam supplied to them in a very wasteful manner, and the admittedly great convenience of electric cables for conveying the motive power to the motors. If this were done the central plant should consist of a number of smaller engines, just as with dynamos at a central lighting station, which could be put on or off as the load came on or off; otherwise, in the event of the central engine breaking down, everything would be at a standstill. Unless there were a duplicate plant, which would entail large additional capital expenditure, no one could ascend or descend the shaft till the breakage was repaired, and the stoppage of the fan would probably mean serious consequences.

While such a scheme would undoubtedly be economical in motive power, and probably in first cost, it can hardly be considered within the range of everyday practice.

As yet the winding engine, placed close to the boiler, is universally driven by steam, and in spite of the wasteful character which is due to the varying loads, and which necessitates at its maximum load (probably) four times the quantity of steam that its minimum load requires, i. e., when reaching top, it is likely to remain so, unless, as is probable, some such arrangement of electric motors be tried as that suggested. In that case, as the power required by fan, pump and haulage (supposing endless rope to be the system) is pretty regular, the extra power beyond the average required by the winding engine at its maximum can be got from a motor that can be thrown in when required and cut out as soon as done with. Thus used, no waste of power would take place, and there would be sufficient to lift the maximum load in place of steam being kept on the engine all the time, as is generally the case, except when the addition of the cutoff, regulated by automatic expansion gear, and arranged to come into work at a certain engine speed, has reduced this waste of power.

HAULAGE.

If we now consider the question of haulage, much will depend upon the position of the haulage plant and upon whether the colliery is a new or an old one. In the former case the haulage engine may (1) be put at the surface and main and tail or endless ropes taken down the up-cast pit; or (2) the haulage engine may be put down at the bottom of the down-cast pit and steam taken to it; or (3) in some cases both boilers and engines may be put underground, the boilers being fed with a split of fresh air and the hot gases utilized to assist the ventilation. The question of additional haulage plant would not be raised until the management was satisfied that the main haulage, which we will assume to be 2,000 yards in length, could not be extended further.

Let us first consider the case of the haulage required by a new colliery.

At once the question is raised of what motive power is to be adopted, the three possible powers being steam, compressed air and electricity. If the present haulage alone has to be considered and nothing thought of future extensions, the probable verdict will be to place the steam engine at the pit top and take driving ropes down the up-cast pit.

It must be apparent, so long as both the air compressor and the electric generator have to be driven by steam on the top, that a pair of horizontals of equal power driving a steam haulage, a compressed air haulage and an electric haulage, must yield a greater efficiency for steam haulage than either compressed air or electricity, as, whatever the losses may be in the steam engine, to these losses will have to be added, in the case of compressed air, the loss in compression, that in conveying the air down the pit in pipes to the motor and that in the motors. In the case of electricity there is to be added the loss in the generator, the cable and the motor. Against the steam haulage would have to be charged only the additional friction caused by taking the rope from the engine down the pit to the place where the electric motor or compressed air haulage engine would be placed. If we look at it from the point of view of first cost, we have to add the following to the cost of the engines, which is common to all three systems, viz.:

1. In the case of steam haulage, some 1,600 yards of rope, on the supposition that the shaft is 600 yards deep, and an endless rope is used, which would be a very small matter.

2. In the case of compressed air, the cost of the compressor and the air mains.

3. In the case of electricity, there would be the additional cost of the generator, cables and motor.

From this point of view the case in favor of steam haulage is still stronger.

If now the case of a steam haulage engine placed underground and close to the pit bottom is taken and compared with compressed air and electricity as before, we find the following: The efficiency and first cost of the compressed air and electrical haulage plant will remain the same. But in the case of steam haulage we have not only first to deduct the loss of efficiency due to the friction of the additional 1,600 yards of rope, but have to add the far more serious loss caused by the condensation and consequent loss of pressure in bringing the steam from the boilers to the haulage engine, a supposed distance of 800 yards.

The steam pipes would, no doubt, be well covered with non-conducting composition, which, the makers state, reduces the consumption of fuel by 15 to 30 per cent., due, doubtless, to the greatly reduced condensation in the covered pipes.

Mr. W. E. Garforth has stated that at the West Riding collieries steam is taken underground to a pair of 16 inch haulage engines, a distance of 526 yards, with a pressure of but 3 pounds to 4 pounds less than at the boilers.

He instances at the same colliery a pair of 15-inch engines, 187 yards from the boilers, supplied with steam from the top, with a loss of but 3 pounds in pressure and very little condensation.

Mr. H. W. Hughes, in his text book on mining, states that the loss from taking steam down the pit ranges from as little as 4 to 5 pounds to as much as 8 to 15 pounds.

At Broomhill colliery, Northumberland, steam is conveyed to a pump 1,414 yards from the boilers at bank. All pipes are well covered with non-conducting composition, and the loss by condensation is 21 per cent., while the pressure at the pump is 13 pounds below that at the bank.

Mr. Baure has stated that at the Bezinet colliery, France, steam is conveyed 400 yards from the boilers in 8¼-inch pipes with a loss of 18¼ per cent. Thus, apparently, at the very worst, a loss of 21 per cent. is got from condensation in well-covered pipes, while in other well authenticated cases the loss is but some 6 per cent.

This wide range must depend on whether the shafts and roads are wet or dry and whether the pipes are taken down the up-cast or down-cast pit. The additional first cost of this plant would be the cost of the steam pipes and fixing them, from which must be deducted the saving of 1,600 yards of rope.

Mr. W. Meacham has recently stated that the first cost of an electric haulage plant put down at Haden Hill colliery was nearly double the estimated cost of a similar steam haulage plant under the above conditions.

It is clear that the additional first cost of the compressor would be the compressor itself.

On the supposition that there is a loss of 20 per cent. of efficiency, the steam engine still must be the cheaper motive power, both in first cost and efficiency.

The third case, in which both boilers and engine are placed underground, will next be considered.

This must be the most unsatisfactory of the three methods of arranging for steam haulage close to the shaft.

In the case of fiery collieries, which form by far the larger number of the collieries of this country, few, if any, would dare attempt such a thing, and her Majesty's inspectors would be certain to do their best to prevent such a dangerous arrangement.

So far as these collieries are concerned, we may at once dismiss this arrangement, which, however, in non-fiery collieries may be considered feasible, but it has such great disadvantages as to be inadvisable. Allowing that a small Lancashire boiler be required to provide the necessary steam, a second would have to be provided for times when the one required repairs and had to be knocked off for the necessary cleaning.

This alone would entail a large capital expenditure, which would be further added to by the large cost of the necessary foundations and the arches that would have to be turned over the boilers.

The providing of suitable water, free from excess of lime and CO_2, is frequently an insuperable difficulty, and, if found, would require to be carefully collected and piped down the shaft to the boilers. The boilers would doubtless be placed in an intake, and should, if possible, have but a short return to the up-cast shaft, where the gases would be utilized for assisting or creating the ventilation, together with the exhaust steam, unless arrangements were made for the condensation of the latter by the engine itself, which would be feasible if the system of haulage be endless rope.

To keep this road, arching would be necessary throughout, which would be a further expense. The cost of repairs to the boiler would certainly be great, owing to probable heavy firing during the working day and the daily after-contraction consequent upon the dampers being put in.

Thus the first cost of boilers and haulage engine would in this case fully equal the first cost of either the electric or compressed air plant.

An increased efficiency would doubtless be secured, as the full boiler pressure should be obtained in the engines. An additional man would be required to look after the boiler, and a considerable part of the fuel used would be additional to what would have been used had steam been brought from the top, both of which must add to the working cost. Beyond this there is the constant danger of firing either carbonaceous matter in the surrounding strata, or more probably the seam of coal itself in which the plant would probably be placed, unless an air space has been left all round the boiler seating and arching and part at least of the boiler flue. Summing up, the advantage of an increased efficiency would, in the writer's opinion, be outweighed by the increased working cost and the much larger first cost, and this arrangement is considered by him inadvisable, even in a non-fiery colliery.

Mr. A. L. Steavenson, when comparing the three powers—steam, compressed air and electricity—came to the conclusion that, for distances of less than a mile, ropes driven by an engine placed at land were cheapest, and for distances of a mile to 2,000 yards wire ropes gave results equal to any system of transmission. In his paper he quoted Prof. Reynolds, who stated that ropes have been found without question the most efficient means of transmitting power at long distances.

Haulage driven by means of a separate endless shaft rope is certainly the best method of bringing the ropes from top, the slow speed at which such ropes travel almost preventing breakage, while yielding a long life. In case of breakage, too, the defect is soon remedied, while main and tail ropes are frequently taken down shafts where the roofs are not good enough to allow of the width of road necessary for endless rope haulage. The higher speed at which these ropes must run greatly adds to the risk of breakage. The writer has frequently been struck with the needlessly high speed at which many main and tail ropes are driven. It is a pretty and striking sight to see a train traveling fast, but the consequent wear and tear of the rolling stock, the road and the ropes should be considered, and a rate of speed forbidden beyond that which is absolutely necessary to comfortably meet the cage. If possible, to prevent delay in case of accident, the ropes should be taken down the up-cast or fan shaft, which shaft, it is presumed, will be used for ventilation only, for raising and lowering men and for putting down timber. The ropes, too, should be allowed to hang clear in the shaft, simply passing over pulleys at the top and bottom of the shaft. This, in case of a broken rope, will prevent delay, and also, in the writer's opinion, prevent the great loss of time that has occurred with main and tail ropes when the rope has sloughed, probably at the entrance to the wooden rope trunk. Should the system of hauling be main and tail, it would be well to stop the rope while men are raised and lowered in the shaft.

While in the writer's opinion there can be little doubt that haulage driven by steam on the top and haulage driven by steam taken down the pit is more efficient and cheaper in first cost than when either air or electricity is used, and that with boilers placed underground the efficiency is probably greater, the first cost is approximately the same, and the working cost the same as for either compressed air or electricity, yet when the time has come for the main haulages to be extended the conditions are quite altered.

We will suppose that the main haulage plane of a fiery mine is 2,000 yards long and has to be extended, say, a further 1,500 yards.

COMPRESSED AIR VERSUS ELECTRICITY.

Reliable data are now obtainable to decide the relative efficiency of compressed air and electricity. We will first consider compressed air. In an able paper read recently at the South Wales Mining Institute Prof. Elliott gave the following figures. On the ordinary simple adiabatic system of air compression, and neglecting certain losses, he found by calculation the efficiency of transmission, i. e., the ratio of the indicated horse power developed in the motor cylinder to the indicated horse power absorbed in the compressor cylinder to give in the case of a pressure of 90 pounds—which is the pressure at which the Popp installation of compressed air at Paris works—an efficiency of 59·5. But Prof. Kennedy found by actual measurement that he got for this efficiency but 46·1, and the difference represents the losses overlooked. Prof. Elliott also found that a compound system would have a possible efficiency of 77 per cent., and the triple system a possible efficiency of 84 per cent. On correcting his estimate in the ratio of 46·1 to 59·5, he got the probable actual efficiency of:

	Per cent.
Simple	46·1
Compound	59·8
Triple	65·2

If, however, we take this efficiency to be the ratio of the indicated horse power in motor cylinders to indicated horse power developed in the steam cylinder of the compressor, and making the same correction, we get:

	Per cent.
Simple	39·1
Compound	50·7
Triple	55·3

Allowing for losses on the scale found to exist by Prof. Kennedy in the Paris machinery, and reckoning from the steam cylinders to the motor cylinders, we get the following probable efficiency:

	Per cent.
Simple compressor and simple motor	39·1
Compound compressor and simple motor	44·9
Triple compressor and simple motor	46·9
Compound compressor and compound motor	50·7
Triple compressor and triple motor	55·3

Prof. Kennedy in the Paris experiments found the mechanical efficiency of the motor to be 0·67. This is somewhat low. If we take 80 as a good average value of the mechanical efficiency of the motors, we have for the efficiency of the several systems under the conditions assumed and reckoned from the steam cylinders of the compressors to the driving point of the motors the following results:

	Per cent.
Simple compressor and simple motor	31·28
Compound compressor and simple motor	35·92
Triple compressor and simple motor	37·52
Compound compressor and compound motor	40·56
Triple compressor and triple motor	44·24

Take an installation working on the simple adiabatic plan at the reservoir pressure of six atmospheres absolute, the saving of indicated horse power in the steam cylinders of the compressor which would be effected on replacing the old by each of the new systems would be found by calculation to be:

	Per cent. saving.
Compound compressor and simple motor	12·9
Triple compressor and simple motor	16·7
Compound compressor and compound motor	22·9
Triple compressor and triple motor	29·3

These figures show that with the ordinary simple compressor but 31·28 per cent. of efficiency is got, which in general practice probably would drop to 20 per cent., or at most 25 per cent., and if a compound compressor and a simple motor be used, as have been adopted for several large air compressing plants now being put down in South Wales, an additional 4⅔ per cent. is got. If both compressor and motor are compounded, as has been done at the Newbattle collieries, an additional 9¼ per cent. is obtained.

These figures are not encouraging, and it may be questioned whether the additional efficiency obtained from compounding the compressor, or both compressor and motor, will authorize the additional capital expenditure necessitated by the additional plant.

Practically, with the same pressure of transmission we can obtain this increased efficiency; or with the same efficiency we can obtain a reduction in the size of the supply pipes and plant if we adopt a higher initial pressure, which probably would be found the better plan financially. The following are some of the practical difficulties which cause this low efficiency and the suggested and practical remedies.

The isothermal system of compression having been found unattainable in practice, adiabatic compression alone has to be considered.

(To be continued.)

One hundred miles of the Uganda Railroad have been completed and will be thrown open to traffic at once. There remain 300 miles to be constructed before the Victoria Nyanza is reached. The last 40 miles were laid down in a little over two months.

ELECTRICAL NOTES.

According to the English journals the declaration of "Officier de l'Ordre Léopold" has just been conferred upon Prof. D. E. Hughes, of London, by the King of Belgium, says The Electrical World. The Hughes type printing telegraph has been used largely on the Belgian government lines for over twenty-seven years.

At the end of October, 1896, there were in use in Paris 545,914 electric lamps and in London 1,178,000, according to Zeitschrift für Architectur. The feeding current was in Paris 8,107,353 kilowatt hours and in London 10,000,000 kilowatt hours, approximately. In Paris the price per kilowatt hour was 1·25 franc and in London 0·65 franc.

The Baltimore and Ohio Southwestern Railway has been trying electric motors on turntables, says Locomotive Engineering. It cost an average of less than one-half a cent for each time the table was turned. When the same table was operated by hand, it cost twelve cents for each engine. The yearly saving is said to be about $700.

We believe it is a general stipulation in American tramway specifications that the trolley wire should stand a breaking strain of 30 tons per square inch. To some extent consulting engineers in this country, says the English Electrical Review, are insisting upon a similar strength; but it is questionable, not only whether 30 tons is necessary, but whether that figure is ever obtained in ordinary practice. From some recent tests carried out on both English and American trolley wires, it would appear that the average test is about 23 tons per square inch, as will be seen from the following:

ENGLISH WIRE.		Tons per square inch.
Sample A	No. 0	25·4
Sample B	No. 0	23·9
Sample C	No. 0	23·9
Sample D	No. 0	24·07
AMERICAN WIRE.		
Sample A	No. 0	20·2
Sample B	No. 0	23·4
Sample C	No. 0000	21·1

It would, at any rate, appear that some of the American wire sent to this country is a long way short of 30 tons per square inch, though it would no doubt withstand all the strains that are likely to be put upon it in practice.

The Pennsylvania Railroad Company has decided to lend its aid in the work of solving the problems, also doing this in co-operation with the mechanical engineers and scientists and men of financial authority who are associated with George Westinghouse. The Pennsylvania company has already laid a track for the purpose of making these experiments which offers five miles of trackage, and is placed in a singularly convenient region for the accurate testing of various plans and inventions, the swift remedy of defects and the careful study of every appliance which any person may offer for inspection or test. The tracks, says The Philadelphia Press, have been laid down in East Pittsburg, almost parallel with the Pennsylvania Railroad tracks, although in the valley beneath those tracks, in which the Westinghouse works are situated. Already in those vast yards a system of electric propulsion has been in use for several years. By it the freight cars, which are switched into the yard and which carry from the works the machines destined for distant markets, have been hauled with economy, perfect ease and method. It is what is known as the button system. The third-rail system is also to be tested in every detail. The tracks which the Pennsylvania Railroad has established, and which the Westinghouse people are utilizing with an electric car, are supplemented by two interior rails. That is to say, it is not a single third rail system, but is what may be called the double third-rail system. This system is now being tested upon these tracks, very largely for the purpose of determining whether the element of danger can be completely eliminated, and, if this can be done, whether the system thus established can be operated as economically and as satisfactorily in other ways as the third-rail system with the live rail, such as President Clark is using upon the branch line near Hartford, Conn.

A dispatch has been received at the Foreign Office from the British minister at Belgrade, on the subject of a contract between Mr. Hugo Luther, of Brunswick, and the Servian government, which has passed the Shupshina, and has been promulgated as a law in the Servian Official Gazette. The rights conferred on Mr. Luther by this instrument are of a remarkable and extensive nature, says The Electrical Review. He will enjoy for 99 years the exclusive privilege of drawing mechanical and electrical power from the cataracts on the Servian shore of the Danube, and of applying same to any industrial undertaking on which he may decide to embark. During the first 30 years of this period his plant, buildings and industrial undertaking are exempted from the payment of every description of impost, taxes, octroi or custom dues on the importation and exportation of machinery, material and produce. Within four years from the date of the contract, Mr. Luther must erect motor plant and buildings at the cataracts to the value of 2,000,000 dinars, and electric power for working purposes must be available within a period of eight years, failing which, he forfeits all his rights under the contract, with the exception of those over mines. Within 30 years electricity to the amount of 15,000 horse power must be forthcoming, and every cataract then unused by Mr. Luther reverts to the state, which may allot them to other parties after Mr. Luther has been given the option of using them. At the end of 99 years the state may exercise a right of pre-emption over the power-producing plant and buildings. All matters of dispute between the state and the concessionaire are to be adjusted by a court of arbitration to be specially appointed, whose members will be chosen in equal proportion by the government and by Mr. Luther. This measure places mineral forest resources of nearly 600 square miles of the northeastern portion of Servia under the control of foreign capitalists. The capital required by Mr. Luther will probably be shortly raised in Germany.

MISCELLANEOUS NOTES.

A diamond in constant use for cutting cold glass lasts about three months, but if, used to cut hot glass, it would only last for one day.

Sumatra petroleum promises to be a rival of Russian and American oils in Japan. A Yokohama firm has ordered 40,000 cases of the Sumatra oil. The packing cases are to be made of American lumber.

The general annual return of the British army for 1896 shows an average effective strength of 220,742, subdivided thus: Household Cavalry, 1,300; Cavalry of the Line, 16,284; Horse Artillery, 3,785; Field Artillery, 14,451; Mountain Batteries, 1,408; Garrison Artillery, 17,663; Royal Engineers, 7,833; Foot Guards, 5,850; Infantry of the Line, 137,022; Colonial Corps, 3,218; Army Service Corps, 2,517; Ordnance Corps, 1,310; Medical Staff Corps, 2,682; and Army Pay Corps, 569. 76,937 of all ranks were quartered in England, Wales and the Channel Islands, 3,650 in Scotland, and 25,841 in Ireland (being an average at home of 106,408), 38,864 in the Colonies and Egypt, and 75,450 in India. The net loss from desertion was in the downward direction, namely, 3,307, as against 3,453 in 1895, and 5,423 in 1886. In addition there are 78,182 Reservists, 117,778 Militia, 30,374 Militia Reserve, 10,362 Yeoman Cavalry, 220,034 Volunteers.—Army and Navy Journal.

Certainly there is nothing more uninteresting to the metallurgist, says The Engineering and Mining Journal, unless it be an essay in pure mathematics, than an account of the redetermination of the atomic weight of a certain element. The question is often asked, Why are new determinations important? Are not those now accepted good enough for practical purposes? To this question Mr. F. W. Clarke makes the following answer: There are two rival values for the atomic weight of chromium. The 52·5 based on the old work of Berlin is still used by European analysts; the other, 52·1, based on later and more accurate researches, is used in the United States. The Baltimore chrome ore works import chromic iron in cargoes of about 2,300 tons, which are assayed in Glasgow and Baltimore. The chemists of the former city based their percentage calculation on the atomic weight of chromium, 52·5, and those of the latter place on 52·1. The variation in percentage resulting from this amounts to a difference of $367.50 in the value of a cargo.'

It is not uncommon for noblemen with picture or sculpture galleries 100 feet long to find a difficulty in keeping their servants. Lord Londonderry has a gigantic house in Wynyard Park, Durham, 300 feet long, which is bad enough; but the sculpture gallery, which is 101 feet long by 58 feet high, contains no less than 700 pieces of statuary and 300 paintings. This gallery has to be swept out and dusted every day. Suffice it to say that Lord Leconfield is the owner of Petworth House, a truly wonderful building, 322 feet long, and containing over 100 rooms, many of them of vast proportions. The Duke of Richmond's house at Goodwood, with its two wings, measures 378 feet, and gives employment to over sixty domestics. There are 125 rooms in Castle Howard, the Earl of Carlisle's residence near Maldon, Yorks. When it was refurnished some years ago, forty suites of new furniture were required. We will conclude with a brief reference to Eaton Hall, Cheshire, the seat of the Duke of Westminster. The writer well remembers, when going over this house, being taken to a corridor which runs the whole breadth of the building. "How far is it to the other end?" I asked. "Four hundred and seventy-two feet," was the reply.—Illustrated Carpenter and Builder.

A new ticket printing machine now being introduced to the notice of the English railway companies is designed to simplify the work of the ticket issuing department and to facilitate audit, says The Colliery Guardian. This new machine is intended to supersede a central ticket printing office altogether, and to enable the booking clerk to print each ticket as it is asked for by the passenger. At one side of the machine there is a wheel on the circumference of which are engraved the names of the various stations. This is turned round until the name of the station for which a ticket is desired comes opposite the pointer. In front are several levers; when one of these is touched, according to the class required, a printed ticket is forthwith delivered bearing the names of the stations from which and to which it is available, the class, the fare, the date, the serial number, and any other particulars that may be wanted. If the pressure on the lever is continued, tickets printed in this way, and all serially numbered, may be poured out at the rate of one hundred a minute. At the same time the number, distinction and price of each ticket issued are automatically registered on continuous rolls of paper, one for each class, which are locked up within the machine and can only be reached by the official to whom the key is intrusted.

Japan has shown herself so remarkably go ahead in recent years that we read now without much surprise of the strides made by her chief ports and cities, says The London Financial News. Hakodate is no exception to the general rule, and our consul there, in his report on its trade during 1896, gives some striking figures. The total foreign trade of the port last year amounted in value to £132,689, an increase of £34,860 on the total in 1895, or at the rate of nearly 35 per cent. The exports rose from £81,075 to £97,300, while the imports more than doubled, leaping from £16,704 to £35,279. This was partly due to the importation of railway material. In the table of exports those to China stand first with a total of £37,329, against £45,873 in 1895; but in the import table the flowery land is last but one, with the insignificant total of £139, against £181 in the previous year. Exports to the United States come next—£22,283—a falling off of 1895's figures of about £3,000; while the imports thence stand lowest with £75 only for 1896, against £218 for 1895. Exports to Russian Asia rose to £10,963 from £2,471 in the preceding year; and the imports thence sprang from £5,007 in 1895 to £16,650. Great Britain, which stands fourth in Hakodate's list of exports, is an easy first in the list of imports, the figures being £18,149, against £11,124 in 1895. This, although not such a relatively large increase as the imports from Russian Asia, shows that our commercial intercourse with this rising Japanese port is being well sustained.

SELECTED FORMULÆ.

Poultry Food.—There is a great similarity between the various poultry powders and foods. The powders are popularly supposed to increase the egg-laying power of hens. We quote a few typical formulas:

Powdered eggshell or phosphate of lime	4	ounces.
Iron sulphate	4	"
Powdered capsicum	4	"
Powdered fenugreek	2	"
Powdered black pepper	1	"
Silver sand	2	"
Powdered lentils	6	"

A tablespoonful to be mixed with sufficient feed for twenty hens.

Oyster shell, ground	5	ounces.
Magnesia	1	"
Calcium carbonate	3	"
Bone, ground	1½	"
Mustard bran	1½	"
Capsicum	1	"
Sodium chloride	1	"
Iron sulphate	½	"
Sodium carbonate	½	"
Sulphur	½	"
Beef, lean, dried and powdered	10	"
Fine sand	10	"
Corn meal	20	"
Linseed meal	20	"

Reduce all to moderately coarse powder and mix well.

The above are formulas that are recommended by poultrymen, and pharmacists should not condemn them, even if they do seem polypharmic. Poultrymen have ideas of their own about the value of complicated formulæ.—American Druggist.

Luminous Calcium Sulphide.—Calcium sulphide as used in the manufacture of luminous paint may be prepared upon the small scale by the following process: Boil for one hour 2¼ ounces of caustic lime, recently prepared by calcining clean white shells at a strong red heat, with 1 ounce sulphur and 1 quart soft water. Set aside in a covered vessel for a few days; then pour off the liquid, collect the clear orange colored crystals which have deposited, and let them drain and dry on bibulous paper. Place the dried sulphide in a clean graphite crucible provided with a cover. Heat for one-half hour at a temperature just short of redness, then quickly for about fifteen minutes at a white heat. Remove cover and pack in clay until perfectly cold. A small quantity of pure calcium fluoride is added to the sulphide before heating it. It may be mixed with alcoholic copal varnish. Sulphides of barium and strontium also give phosphorescent powders when duly heated. Each sulphide has a predominant color, but the temperature to which it is heated has a modifying effect on the color. Calcine in a covered crucible, along with powdered charcoal, sulphate of lime, sulphate of barytes, or sulphate of strontia; there is produced in each case a grayish white powder, which, after exposure to strong light (either sunlight or magnesium light), will be phosphorescent, the color depending on the sulphate used and the degree of heat employed.—Pharmaceutical Era.

To Color Iron Blue.—One hundred and forty grammes of hyposulphite of soda are dissolved in a liter of water (4½ ounces to 1 quart); 35 grammes of acetate of lead are dissolved in another liter (1¼ ounces to 1 quart); the two solutions are mixed, are made to boil, and the iron is immersed therein. The metal takes a blue color, such as is obtained by heating it.

Receipt for Ink to Write on Glass.—

Water	500	parts.
Borax	75	"
Alcohol	300	"
Fish glue	40	"
Methyl violet	3	"

By volume. The ink is indelible, and very easily applied to the surface of the glass.—Cosmos.

To glue celluloid to wood, leather, etc., use a mixture of 1 part of shellac, 1 part of camphorated spirits, and 3 or 4 parts of 90 per cent. alcohol. A collodion solution may also be used, or an alcoholic solution of fine celluloid shavings.—Uhland's Wochenschrift.

To color ivory brown, apply several coats of an ammoniacal solution of potassium permanganate. Similar results are obtained if the solution is diluted with vinegar, and the ivory article allowed to remain in the liquid for some time.—Uhland's Wochenschrift.

To whiten old ivory, wipe it with flannel which has been wetted with essence of turpentine, then expose for several days to the sun.—La Vie Scientifique.

A Solder for Aluminum.—As an important article in mechanical construction, aluminum is slowly but surely finding a place for itself, but one obstacle to its more general introduction has been the difficulty experienced by manufacturers to find a solder that will successfully effect a juncture between parts. The Journal of the Franklin Institute now gives a recipe for a solder which is said to serve the purpose. It is called Green's solder, and is composed of zinc 50·03 per cent., tin 47·99, aluminum 1·76, and phosphorus 0·22 per cent. It is not used with any flux, simply requiring the aluminum faces to be cleaned and first coated with the solder, then with a clean hot soldering bit to wipe the soldered joint to be made. This may be a very good solder, but if such extreme accuracy as the decimals imply is really necessary in apportioning the ingredients, we fear it will operate against its general use.

Adhesion of Cork to Metal.—In fastening cork to iron and brass, even when these are lacquered, a good sealing wax containing shellac will be found to serve the purpose nicely. Wax prepared with resin is not suitable. The cork surface is painted with the melted sealing wax. The surface of the metal is heated with a spirit flame entirely free from soot, until the sealing wax melts when pressed upon the metallic surface. The wax is held in the flame until it burns, and it is then applied to the hot surface of the metal. The cork surface painted with sealing wax is now held in the flame, and as soon as the wax begins to melt, the cork is pressed firmly on the metallic surface bearing the wax.—Pharm. Centralhalle.

SCENES AROUND PNOM-PENH, THE CAPITAL OF CAMBODIA.

ONE of our correspondents in Pnom-Penh sends us a few interesting photographs of this region, which but very recently was causing itself to be talked about. It was a question of nothing less than a coup d'etat, as a sequel to which King Norodom was dispossessed of his throne under the pretext that he had given signs of mental alienation.

In the train of these events, the resident general was changed, and replaced by M. Ducos, whose merits have caused him to be highly appreciated in these quarters.

This region is of uneven aspect, with a central canal of which the emanations are unwholesome to such a degree as to cause cholera when the water gets low. The landscape is picturesque; and picturesque, too, are those returns from hunting that unite numerous sportsmen around the game that has been killed during the day. Wonderful accounts are given of these hunting expeditions, in which there usually occurs a surprising slaughter of pea fowl, deer, and wild boars, the number of which would make our European Nimrods pale with envy. But, doubtless, more original still is this imposing line of elephants massed in an alley of the garden of the official French residence, and upon which are seated the guests invited to an excursion organized by Mme. Ducos. One thinks involuntarily of Hamilcar's elephants in the narratives of the battle of Salammbo.

As a background to the picture, we see curiously and capriciously profiled the pyramidal towers of the pagoda of Pnom-Penh, one of the most celebrated edifices of the country. This pagoda, it is said, was erected through the piety of Lady Penh, a Cambodian of ancient times.

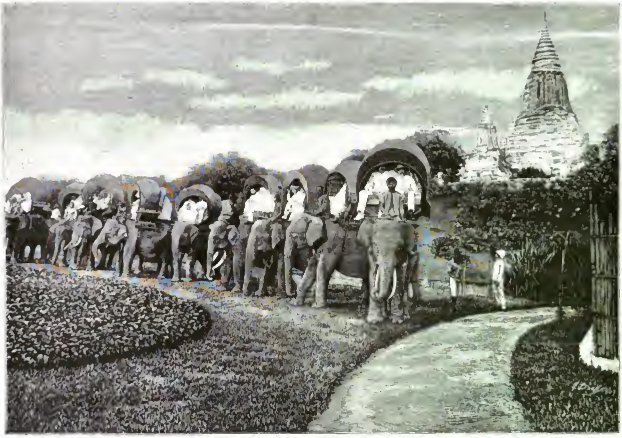
The capital of Cambodia, moreover, borrowed its name from the hill upon which this edifice stands. The name is from pnom, "mountain," and penh, "great abundance."

The hill was made by the hand of man, and the pyramid was erected over the place of sepulture of him who had it constructed, some eight hundred years ago, that is to say, along about the year 1080 of the Christian era, or in 1600 of the Buddhic era of Cakia-Mouni, the golden age of Khmer architecture.

If tradition is to be believed, the Khmers were one of the first barbarous tribes that occupied Cambodia. Aside from the structures that are attributed to their art, and of which the pagoda of Pnom-Penh and the celebrated ruins of Ang Kor give the best idea, scarcely anything exists relating to them except legends. The latter speak of a certain Bautumo Saurivong, whose name in Hindoo signifies "the lotus, son of the sun," and to whom the pagoda of Ang Kor is attributed. The present Cambodians consider themselves as the descendants of these Khmers.

Pnom-Penh is situated upon the left bank of the Mekong, near the confluence of the arm of the lake, at 138 miles from Saigon and 84 miles to the north of the Gulf of Siam.

The city is built upon a marvelous site. It is the residence of the king, of the resident general of France, and of the resident of the province. Although the smallest of the Kingdom, this city is the richest and most densely populated. It contains 340,000 inhabitants. Besides the pagoda spoken of above, there are here several other prominent edifices, the principal of which are the king's palace, the habitation of the chief of the bonzes, and the elegant buildings of the French protectorate, opposite which there is a large pleasure garden, the flower beds of which adorn the shores of the Mekong.—*Le Monde Illustré.*



AN EXCURSION ON ELEPHANT BACK AT PNOM-PENH, CAMBODIA.

THE MUSÉE SOCIAL AND ITS WORK IN SWITZERLAND.*

THE Musée Social of Paris, France, is a privately endowed but public institution, the object of which is to advance the study of practical labor questions throughout the world. Though in no way a state institution, it may be said to be a labor bureau the maintenance of which is provided for by funds with which it has been privately endowed. Under these circumstances its organization and work merit a special interest. The Musée was created in 1894 by the Comte de Chambrun, who gave for that purpose the sum of 1,700,000 francs ($328,100), but it was not definitely organized and inaugurated until March 25, 1895. Its objects, in the language of the constitution, are "to place gratuitously at the disposition of the public documents with collateral information, models, plans, constitutions, etc., of social institutions and organizations which have for their object and result the amelioration of the material and moral situation of the laboring classes."

Unlike the various economic associations and societies, it as far as possible avoids mere academic discussions, and confines its attention to matter relating to practical labor questions. In this it follows strictly the line of work of official labor bureaus. In a building owned by it, it has accumulated a library of all the principal official reports, publications of private associations and industrial organizations, and private treatises printed in all languages bearing upon practical labor problems. It has fitted up rooms for lectures and meetings and for students who desire to make use of the library. It has a permanent exhibition of models, plans, etc., of workingmen's houses, devices for preventing accidents, constitutions of social institutions of all kinds, etc. It provides for lecture courses on labor problems.

As regards its own direct contributions to a knowledge of labor conditions, it from time to time organizes special commissions in France and in foreign countries to inquire into labor subjects of present practical importance. The publications of the Musée Social naturally constitute a very important part of its work. Of these there are several kinds. It issues from time to time volumes in a series entitled Bibliothèque du Musée Social, which give the results of its investigations and other material representing the results of original research. The second class of publications consists of more frequent bulletins, or circulaires, as they are called, for the publication of shorter contributions. There are two series of these bulletins, the first of which is intended for a wide gratuitous circulation among the working classes and is devoted to giving information concerning current happenings relating to labor, such as the meetings of labor congresses or organizations, social legislation, etc. The second series embraces studies more in the nature of economic monographs. A most important feature of these bulletins is the valuable bibliography of reports and works relating to the question under treatment, which is always appended.

The bulletins relating to the insurance of workingmen against idleness in Switzerland are of such general interest that their contents are here summarized. Switzerland is apparently the only country in which serious efforts have been made to lessen the evils of lack of employment through the creation of special state insurance institutions. The first attempt to provide for insurance against idleness under government auspices was made by the town of Bern, in April, 1893. It provided for the creation of an institution, membership in which was to be purely voluntary. Each member was required to pay monthly dues of 40 centimes ($0·077). To the fund thus accumulated the town agreed to add a subsidy the maximum amount of which was limited to 5,000 francs ($965) a year. The constitution also provided for the receipt of gifts from employers and other individuals. This relief would be granted only during the months of December, January and February.

Only members of six months' standing who had paid their dues regularly and had been unemployed at least fifteen days are entitled to benefits, and then not for the first week that they are without work. A workingman who refuses work of any kind loses all right to aid of any kind. There are also other cases in which the workingman loses his right to a benefit. Such, for instance, are the cases where he is unemployed as the result of his own fault, and especially when he has engaged in a strike. The fund is administered by a commission of seven members, of which three are named by the municipal authorities, two by the employers contributing to the fund, and two by the workingmen.

This institution has now been in existence a sufficient length of time to furnish some indication of the character of the results. The members have contributed but 14 per cent. of the total receipts and they have received in actual benefits six times the amount paid in by them as dues. One would think that under such exceptionally favorable circumstances membership would increase rapidly. Such, however, has not been the case. During the second year, 1894-95, there were but 390 members, or 14 less than the preceding year. Two hundred and nineteen persons, or more than half the members, were aided. They received $1,890.06, or an average of $8.58 each. This institution had been founded for but two years as an experiment. In 1895, the two years having elapsed, the town council determined by an almost unanimous vote to continue it in operation. Some modifications, however, were introduced in its organization, and the municipal employment bureau, which had until then been an independent service, was attached to the work of the insurance fund.

Saint Gall, a town of about 30,000 inhabitants, was the first to follow the example of Bern and provide for the insurance of workingmen against idleness. Its policy, however, differed radically from that of Bern, in that it adopted the policy of compulsory insurance. Its institution was created June 23, 1895. After an existence of about a year and a half, its suppression, after June 30, 1897, was voted by a majority of the electors of the town November 8, 1896. The reasons for its abolishment were that the system of compulsion worked badly. At Basel, although no scheme of insurance has as yet been put into operation, a proposition for the compulsory insurance of workingmen

* Bulletin of the Department of Labor, Washington, D. C., March.—Public Opinion.

against lack of employment through a municipal institution has been elaborated, in which the attempt has been made to meet the objections that were urged against the Saint Gall experiment. The question of insurance against lack of employment has also received attention in other Swiss cities, notably Zurich and Lucerne, but no actual steps in this direction have as yet been taken. The federal government is now prosecuting an investigation of the whole subject of lack of employment and the means of preventing or lessening the evils resulting from it. The complete report of this investigation has not yet been made.

ALFRED KÖCHER AND HIS PACE MAKERS.

WE publish herewith an engraving of Alfred Köcher and his pace makers. For this picture, which was taken from an instantaneous photograph, we are indebted to our worthy contemporary the Illustrirte Zeitung. At the races which were arranged in the Friedenau-Wilmersdorf Park, near Berlin, for the benefit of the sufferers from the flood, Köcher succeeded in making 1·8 miles in 3 minutes 31⅘ seconds, thus beating the 3 minutes 32 seconds record of Joseph Fischer, which had formerly led the world. Köcher also made the road run of 62 miles in six minutes less than it had been made before, covering the distance from Zossen to Lübben and back in 2 hours, 51 minutes and 53¼ seconds.

ALFRED KÖCHER AND HIS PACE MAKERS.

THINGS AMERICAN.

By MARCUS BENJAMIN, Ph.D.

IT is a curious peculiarity of most people that they desire to obtain some reminders of places that they have visited. In a way, the habit is a good one, but, unfortunately, it is apt to degenerate into vandalism, and a piece of a curtain from the Palace of Sans Souci or a button from a Napoleonic uniform, obtained at the price of a generous douceur to the guide, is too frequently the kind of souvenir that the traveler brings back from abroad with him. On the other hand, a carved piece of bogwood from Ireland, a bit of porcelain from Sevres, a mosaic from Florence, a sash from Rome or a piece of glass from Venice, a miniature wooden chalet from Switzerland, an agate from Oberstein, or something in iron from Berlin, are indeed pleasant reminders of a visit to the old world.

It has often seemed strange to me that Americans, who travel so much about their own country, should have so completely ignored those things that are peculiar to the many places within our own land; and yet there is scarcely an important city in the United States that has not some one thing that is made nowhere else. Some of these deserve special mention, and as an interest, largely fostered by our sons, daughters and dames of patriotic societies, has been developed in "Things American," it seems well to describe some of the "things" that I have gathered.

At first blush it would appear as if in so great a city as New York, where everything can be had, no matter from where it originally came, no special memento, peculiar to the metropolis itself, was procurable, and yet there is nothing so artistic, so beautiful and so unique among the products of American industries as the Favrile glass, which Mr. Louis C. Tiffany has recently invented. It is made into a variety of original forms in vases and other objects of interest to collectors and lovers of art.

The new combinations of color with color, of color over color, the deepening of tone, the subtile quality of the texture, the introduction of new colors, the union of metal with glass, and the wonderful ornamental effects obtained by embedding lines and threads of one colored glass into that of another while they are in a molten state and during the operation of blowing, are among the characteristics of this beautiful invention.

As we journey from New York toward the South, Trenton is reached, and the collector of things beautiful would, indeed, find it a difficult task to get away from the sample rooms of the potteries of that city. Perhaps, if he goes to the right place, he may find some bit of modern historical ware, such as the exquisite pieces of Belleek, that were made for the World's Fair, held in Chicago; or a piece of the china set, with the heads of George and Martha Washington, that were made in 1876. There is also an interesting after-dinner cup and saucer, that I recall having seen, that was made for the New Orleans Exposition, in 1881.

Philadelphia is large, and while there may be things that are more characteristic, I have contented myself with the quaint toby jug, in old Rockingham ware, made there, and the two English plates, made in 1876, with prints of Independence Hall and the public buildings on them. The Mint affords one an opportunity of securing a specimen set of the silver coins or, perhaps, one of the medals made there, certain of which are exceedingly beautiful.

As we go west from Philadelphia, Gettysburg—famous as the field of the greatest of modern battles—may be taken in on the way. Bullets, pieces of shell, bayonets and the like are still common and far too plentiful to be other than genuine. It was less than ten years after the battle when I first visited the field, and then, among the "relics," that which most attracted my attention was a lamp, the bowl of which was made from an unexploded shell that had been carefully emptied of its dangerous contents.

At Summit Hill, in Carbon County, Penn., are to be had what are called "anthracite coal novelties." These are simply carvings in the hard coal, which takes a polish similar to jet; and they are quite attractive, especially when care has been taken to secure a specimen containing a vein of pyrite.

The largest aluminum works in the world are, probably, those near Pittsburg, and a pleasant souvenir of a visit to that city, so noted for its metallurgical works, is a plaque of the coming metal. A medallion, with the head of Woehler, who discovered the element, modeled in high relief, brings to mind some bitter cold days spent there several winters ago.

Baltimore is the home of the Chesapeake Pottery, and a specimen from its kilns—perhaps a cracker jar—in the Severn or Calvert pattern, is something that cannot be found in every city; while the "Rebekah at the Well" teapot, that originated in a pottery nearer the center of the city, is still procurable, but certainly not in the bric-a-brac shops, for there they prefer to sell, at fancy prices, English cups and saucers, decorated with views of the city.

The rare old blue plates with which the Baltimore and Ohio Railway celebrated its completion in 1828 will sometimes reward the antiquarian who is willing to spend time and money to secure one of these treasures, on which is printed the little, stumpy locomotive that was built by Peter Cooper, early in the century.

It is in Washington that we find something, perhaps, more unique than elsewhere. No visitor to the capital city of the Union can have failed to have observed the various souvenirs, made of a plastic material and in many shapes, and having a grayish color, that are everywhere for sale. They are of paper pulp, obtained from the government bank notes that have been reduced and macerated at the Treasury Department. The operation is an interesting one to see. Each object bears a small label giving the estimated value of the original bills, and one may easily bring away with him a souvenir with an estimated original value of $50,000. Less unique, but at one time quite common, were bits or chips of stone from the Washington Monument. On many of these were crude paintings of the tall white shaft, or else of some public building in Washington. At Mount Vernon canes and other commonplace objects in wood, grown on the place, are for sale, but they are without special interest.

The battle fields of Virginia afford relics, and a company in Richmond, Virginia, advertise a tastefully finished cane, ornamented with a silver plate, upon which is inscribed the name of the battle field from which it came, cut from any one of the following historical fields of the late war: Seven Pines, Fair Oaks, Gaines' Mills, Garnet Farm, Malvern Hill, Cold Harbor, or Petersburg.

The deposits of phosphate rock in South Carolina yield fossil sharks' teeth that form convenient paper weights, which are common in Charleston, where also the brilliant plumage of semi-tropical birds may be purchased, and with which fans are easily made. In Florida, especially in Jacksonville and St. Augustine, there are stores where paper cutters and other objects, carved from orange wood, are to be had. Stuffed alli

gators, so small as to be easily packed in a glove box, are everywhere sold. Fans in bright colors, like those from Cuba and Spain, with views of St. Augustine, from the old San Marco to the modern Ponce, are equally common. Shells and strange seeds, made into jewelry, abound; while pieces of the curious coquina stone, cut in squares or bricks, are sold for a few cents. It is with this material that many of the newer and beautiful buildings in St. Augustine are built.

It is in New Orleans that the curious carving wares from Mexico begin to appear. Here we find the strange pottery from Guadalajara, and the wax figures that the nimble fingers of the native artists fashion with such ease. Many of these are made in New Orleans itself. Nor must the feather work be forgotten, for it is not uncommon. But that which I value most from New Orleans are the Indian Choctaw baskets, that are still to be had in the French market. If the makers of them are as old as the saleswomen, surely, in years to come, they will be rarities of the first water, commanding high prices. Miniature cotton bales, that purport to have been made during slave times, are not without interest, and may be found in shops in Canal Street.

Before leaving the Southern States, it is well to remember that specimens of Confederate postage stamps and Confederate bills are on sale in many of the cities below Mason and Dixon's line.

If we ascend the Mississippi to St. Louis, we may be fortunate in finding some authentic piece of pottery from the mounds near that city. The vicinity is rich in the remains of that prehistoric people about whom so little is known. Indeed, St. Louis itself is on the site of several mounds. Magnificent quartz crystals are to be had for next to nothing at the Hot Springs, in Arkansas. Specimens that exceed in beauty the famous crystals from Switzerland are on sale along the principal street of the resort.

In Texas, steer horns, fully as beautiful as those from the cattle in the vicinity of Rome, Italy, are often to be found, and may be had for the asking. In San Antonio, with its never to be forgotten Alamo, and its beautiful missions that are slowly but surely crumbling into ruins, the products from over the line are sold to the curiosity hunters. Monkey jars and water bottles, feather work and carved onyx are seen in the shop windows.

Turning abruptly north, we find in Denver curiosities that are of Indian origin; but to my mind, the sprouting silver buttons that resemble an open rose are most interesting, while the large green garnets from Salida, that occur in perfect crystals, are souvenirs of greater local interest. Santa Fé is par excellence the place to purchase Indian pottery. Jake Gold's museum is known the world over, and in it may be had genuine specimens from most, if not all, the New Mexican Indian handicrafts. The Navaho blankets, that are so highly prized, are to be had here, while the more brilliant Mexican blankets, made in Santa Fé itself, are sold for far less than elsewhere. The smaller blankets, that cost from $3 to $4 in Santa Fé, readily command $10 to $15 on the Pacific coast. Indian baskets, from the coarse yucca to the more closely woven ones, are to be had, while silver ornaments, made by the Indians, will sometimes reward those who know what to ask for; and the still rarer paintings, on elk skins, are occasionally to be had. Gems, including agates and the turquoise from the Los Cerillos mines, near by, are sold in Santa Fé at reasonable prices, while on the south side of the Plaza are silversmiths, who make the curious filigree silver work that recalls a similar art practiced in Florence and elsewhere in Northern Italy.

From Santa Fé westward along the lines of either Atlantic and Pacific or the Southern Pacific Railways, Indian curiosities are procurable at all the larger towns. The large black ollas from Santa Clara, New Mexico, make handsome ornaments, and certainly much of the grotesque pottery of the Pueblo Indians is worth buying. At El Paso there are Mexican curiosities to be had, and especially if one is willing to cross the river into old Mexico by the only international horse car line in the world he will find large stores where Mexican opals that seem almost to have borrowed their brilliancy from the sun are common, while the rag, wax and feather work are lavishly displayed. Carvings of the so-called Mexican onyx, mostly of fruits, may be bought at reasonable prices, and one firm offers a ninety page catalogue with over one hundred illustrations for ten cents.

Near Fort Yuma, where the train enters California, there is an Indian reservation, and at the railway station the haughty braves who disdain to offer their wares are not loath to part with them for a few dimes. At Los Angeles, Mexican and Indian curios have well nigh disappeared, although here and there old California baskets are to be had, but they command a good price. Orangewood comes again into notice, and slabs of it in all sizes, from a few inches up to a foot or more, are to be had with attractive paintings of either the leaf, blossom and fruit of the tree itself or with the more somber representations of one of the old mission churches that are in the immediate vicinity.

Naturally there are curiosity shops at the delightful seaside resort of Coronado Beach, opposite San Diego. A small herd of ostriches are kept there on exhibition to show the development of a new American industry. An egg, emptied of its contents, or one of the plumes can readily be purchased. Polished abalone shells are found, and the green variety is not so scarce as further north. The shells themselves are often to be picked up on the beach. I remember fans made from a little burrowing owl being sold at Coronado. The wings are spread around the body in a semicircle, and, to say the least, they are pretty souvenirs. The Mexican owls are more expensive.

The red variety of the abalone shell that attracted my fancy was one I found in Monterey. At Santa Cruz seaweeds pressed and grouped on cards seemed common, but they were without interest. A few miles north of Santa Cruz is a group of big trees, and there I secured a square board of the mottled pine with which when polished book covers can be made. I use it as a cover for a portfolio to hold some engravings of the old missions that were purchased in San Francisco.

If there were no other object in view, the magnificent drive of twenty-six miles up Mount Hamilton to the Lick Observatory is worth taking for its delightful experience, to say nothing of the views that are seen as the mountain is ascended. I hope Professor Holden will pardon me if I recall as a souvenir of my visit to Mount Hamilton the print of a photograph of the moon taken at the observatory which he signed for me, and which now hangs in my library, framed crudely in some wood from branches from trees that I cut in descending the mountain.

Chinese curiosities are naturally what are to be found most abundantly in San Francisco. A dirk knife in a carved bone case from Tong Yeun, in Jackson St., is a reminder of a visit to Chinatown, while a knife concealed in an imitation fan is also a trophy from the Chinese quarters. In Oakland it was quite possible until recently to purchase jewelry, such as sleeve buttons and scarf pins, made with thin sections of gold quartz showing the metallic veins set in California gold, and I understand that San Francisco jewelers make some very handsome souvenirs in California gold of different shades for tourists. It is also possible to procure the tiny gold fractional parts of a dollar which were coined at the United States branch mint in San Francisco some years ago. They are no longer made, and certain dates command a premium among numismatists.

There is a Chinese quarter in Portland, Oregon, and there again one may gather curios from the Orient if he so desires. A pack of Chinese playing cards that cost me a trifle, perhaps "two bittee," is the result of an evening's stroll among the haunts of the Celestials. In the vicinity of Puget Sound, as in Tacoma and Seattle, Indian curiosities, chiefly those made by the Indians from Alaska, who come down for a short while during the autumn to pick hops, are to be had. Closely woven baskets, such as those seen in Southern California, are found and also the stone carvings, representing totem poles. In Victoria and Vancouver, in British Columbia, similar curios may be purchased, including spoons made from the horns of buffaloes or perhaps more correctly bisons; also woven mats from Alaska and silver bracelets purporting to be made by the natives, but which are said to be made in Victoria by Indians in order to supply the tourists' demand.

Coming east from the Pacific coast, skins are sometimes procurable, but horns are more common, and frequently a pair of antlers can be picked up from the heaps that are seen in the vicinity of the railway stations. Doubtless here and there bead work can be had, but I failed to find any. It is at Niagara Falls and similar resorts that much of the Indian beadwork made into cushions and the like is to be found.

Indian pipes or calumets made from the mineral catlinite may be bought in the Northwest, and at Sioux City are the works where the agatized wood is cut into slabs, some of which are made into clock faces and the like. These are also to be had in St. Paul. What to look for in Chicago is indeed a question. Relics of the great fire are presumably no longer obtainable, but I well recollect a little bell that purported to be made from the molten metal of the big bells of the City Hall that were common in 1873. Probably souvenirs of the World's Fair held in 1893 would be more easily obtainable. There were many such, and perhaps something has been made from the material of the buildings that were torn down. Exquisite bronzes reproducing in miniature the animals that were conspicuous on the grounds, notably the grizzly bear by Proctor, were made, but they were very expensive. The Columbian half dollars or the Isabella quarters are not bad reminders of the Exposition, and even the tickets of admission, especially those that were so beautifully engraved, are well worth preserving.

At Cincinnati there is the Rookwood Pottery, and its products are everywhere conceded to be exquisite works of art. The "aerial blue" coloring is one of the latest of its many styles and is the most admired by some. The rare Matt Morgan, Kezonta, and Avon wares were also made in Cincinnati, but the potteries where these were produced have long since ceased to exist. Curious pieces of pottery are also to be had in East Liverpool and Steubenville, Ohio. The usual run of curiosities are to be had at Niagara; besides the Indian beadwork already mentioned, birch canoes can be purchased, but most of the articles on sale are from elsewhere, especially the agates. A fossil lingula from the Niagara limestone, found along the line of the river, came to me from the hands of Joseph LeConte, one of the greatest of American geologists, is a souvenir of a visit to the falls with a party of geologists. As we come nearer home I am reminded of a day spent in Utica searching for the American imitations of the old Flemish blue stoneware. Unfortunately, the maker persists in adorning his wares with German legends, but still an interesting collection of "steins" can be procured. In Albany, an enterprising jeweler had made in Austria some articles of the brilliant decorated Hungarian glass, which, even though made in Europe, have designs that recall local events of the times of the Patroons.

In New England souvenirs run largely to pottery. Rare bits of the Chelsea faience are still occasionally to be found in Boston, where also is sold the Longfellow pitcher, which is of English make. The Low tiles from Chelsea are genuine American products. The witch jug from Salem, made at the Hampshire pottery in Keene, is also an American article, while the stranger vases of mottled clay from Gayhead are unique. Curious pipes are also to be had from Cottage City, where the Gayhead Pottery is. Tiles, plates and pitchers abound and are to be had with American views, such as the old tower in Newport or the homes of our New England poets. Here and there are glass factories some of which afford things of interest. The amberine of reddish shaded glass, the Burmese, the Sicilian and the peach blow are among the varieties of interest, none of which are now made, as far as I know, that were found in the show rooms of the glass makers in New Bedford, some years ago, while the old cut glass of Sandwich is held at fancy prices.

No mention of souvenir spoons has been made, and yet the time will come when the better varieties of these will be highly prized by those who were wise enough to collect them when the craze was on. There can be no doubt, it seems to me, that by a judicious selection of the curiosities sold in this country one can fill one's home with interesting "Things American," many of which will recall pleasant visits to various sections of the Union.

THE TOMATO GRAFTED UPON THE POTATO.

The origin of grafting is very ancient. This is not the place to reproduce the history of the art, which is given in special works, but it is likely that man learned it in nature. Who has not seen examples of natural grafting in the woods between the branches or trunks of trees, or the branches of a thick bush?

Nevertheless, as easy as grafting is in many cases, a person who is not up in the art will be amazed upon opening a manual of arboriculture to see the number of varieties of grafts that have been devised by nurserymen and horticulturists, and the knowledge that has had to be acquired in order that the operation may never prove unsuccessful. The great trouble has been and is still to ascertain the affinity between the subject that is to receive the graft and the plant whence the scion is derived. In fact, it is necessary that the anatomical elements of the plants brought into contact

TOMATO GRAFTED UPON THE POTATO.

shall be as similar as possible and that their multiplication shall occur at the same epoch, in order that such elements may unite intimately, and that the graft, firmly fixed, may give the results that are expected from it. Much has been written upon this subject, which is not yet exhausted. However, all are agreed upon one point, and that is that it is indispensable that the plants associated shall belong to the same family, if not to the same genus, in order that the graft may take. If there are any exceptions to this rule, they must be very rare. It is curious to find, even, that some species placed very near each other in classification absolutely refuse to unite, and that the adhesion of others proves of short duration. We may here quote a few remarks from the pen of a master in the art of grafting:

"The explanation of the sympathies and antipathies in the grafting of different species is still wanting. No explanation, either, has been given as to why certain genera can be grafted upon others without the reciprocal being possible. For example, the apple does not succeed upon the pear; while we have seen the latter living for some years upon the former. The pear adopts the quince, and even the white thorn, as a subject, but these plants do not render the same service to their ally. The service, medlar, quince and quickbeam, which are so unlike each other and the white thorn, all sympathize with the latter. The peach and apricot graft upon each other with difficulty, while both succeed upon the almond and plum. All the cherries graft upon the mahaleb, but the latter grafts upon no cherry."

The number of such examples that have been revealed by experiment, but that it is almost impossible to foreknow a priori, might be still further increased.

Grafting has rendered and is still rendering great service in the multiplication of sarmentous plants such as clematises, or, again, of peonies, and even of certain arborescent species which are refractory to propagation by slips; and it is then upon roots that the grafting is practiced, the subjects selected being vigorous species or varieties always belonging to the same genus.

It is also possible to graft annual plants when these have stalks or branches that are sufficiently fleshy, and a striking example of this is shown in the accompanying engraving. It cannot be said, however, that this process has entered into practice, and up to the present it has been merely a matter of curiosity. Carrière, who was a practical man and an indefatigable investigator, tried the most diverse kinds of grafting, and among other results, obtained a crop of tomatoes upon stems of the bitter-sweet. Mr. C. Baltet, an experimenter of

the first rank, has attempted to graft the most diverse plants and has brought together, in a work entitled L'Art de Greffer, very useful directions and advice as to grafting and information as to the species that can be multiplied with certainty by this process.

In grafting branches of the tomato upon stalks of the potato plant, M. Baltet's son has made an interesting experiment that realizes the utile dulci of Horace upon one and the same plant, and which merits being placed before the eyes of our readers, to whom it will show the affinities of two plants belonging to the same order (Solanaceæ) and the possibility of grafting plants which have an ephemeral existence in some regions and which, at first sight, would not seem to be capable of giving so curious results.—La Nature.

THE WEEPING SPRUCE.

OF all our common conifers, the spruce, Picea excelsa, is the most prolific in variations. Some of these are of extraordinary character, some elegant, others ugly. Of pendulous varieties there are several, but none more remarkable than the one figured in our illustration, from a photograph kindly forwarded to us by Mr. A. D. Webster, the superintendent of Greenwich Park. The tree, which measures 30 feet in height, is growing at Ide Hill, Sevenoaks, Kent. We are indebted to the Gardeners' Chronicle for the engraving and particulars.

A WEEPING SPRUCE AT IDE HILL, SEVENOAKS, KENT, ENGLAND.

MARINE PHOTOGRAPHY.

MARINE photography has its peculiar charms. It has also its special difficulties. If the amateur is to derive any satisfaction at all from his "snapshots," he must give a little preliminary study to the nature of the task which he sets himself. It is not enough that he should include among his luggage marked for cabin use, when he boards some oceangoing steamer, or pleasure yacht bound upon a foreign cruise, a two-guinea hand camera with which to secure pictures upon his voyage. With this he may or may not succeed. Chance may favor him or it may reduce him to despair, and he may be tempted to throw up photography as an art which is beyond his aptitude, when, if he only knew the truth, the fault rested rather with the insufficiency of his apparatus than with his want of skill. Success in taking photographs at sea depends very greatly upon an appropriate choice of a camera, and upon what may be termed the modesty of the operator's ambition. Let him first make up his mind what he intends to do, and then let him provide himself with the best possible means of accomplishing his purpose, and, above all, let him not entertain the fancy that with one description of camera he can exhaust the possibilities of marine photography.

The range presented to the devotee of the camera on shipboard is immense. It may be limited to "taking" one's fellow passengers or the sailors, and if it goes no further than this, hand cameras of the customary description may do. But if mere amusement be not the object, if the camera is to serve a really practical and useful purpose, especially if it is to assist the navigator by obtaining permanent records of collision, or damage resulting therefrom, or by securing pictures of coast lines and the like, then something more than a scientific toy is demanded. Intelligent application, and not the mere capricious love of timekilling in an amusing fashion, must stimulate the operator, or he will assuredly fail. And the first thing to recollect is that the photographic lens has a limited vision after all. You have no right to expect of it the wonderful, transcendental powers attributed to the tremendous telescope immortalized by Mr. Weller. It is idle to suppose that it will see with equal distinctness the minute products of deep sea soundings and the distant steamer two miles away. Of course it is possible to strike a happy mean between these two, and the result will be gratification rather than disappointment. But one must bear in mind that short sight and long sight are not reconcilable. If you peer with your camera into the hedgerow, you must not feel aggrieved if it does an injustice to the horizon. And the point is emphasized at sea. One may make certain of a very good negative of the launch of a boat right under the eye, and yet fail to bring two steamers approaching each other within the limits of the plate.

Perhaps marine photographs are especially deceiving, in that they appear to magnify distances. A tugboat plowing its way along one of the reaches of the Thames, as seen in the print, gives one the impression that the camera was at a considerable distance from it; yet, in actual fact, the point of sight was only a few yards removed from the object taken. The difficulty of securing a picture at sea lies in the fact that a considerable space must intervene between the object and the operator, whereby everything is so much dwarfed.

The Diamond Jubilee Review afforded interesting proof of this contention. Various efforts were made to get a satisfactory photographic record of the great naval display, but they have all failed. Perhaps the most successful have been the panoramic pictures obtained by composite printing; but it must always be recollected that a panorama can never be regarded as one picture—it is a series of subjects placed in consecutive order. People who have gone to animated photographic displays with the expectation of enjoying some picture of the review in its entirety have been disappointed. They have come away with a very fair notion of individual battleships, with the incidents around them, such as the passing of a yacht, guard boat, or excursion steamer, but they have not been given a comprehensive idea of the whole fleet. It has been left to the imagination of artists to limn the scene as they supposed it to be, not as they saw it themselves; for the human eye is less powerful than the lens, and where the latter falls short it cannot be supposed that the naked vision can succeed.

As an example of what can be done by the photographer, the work of a clergyman may be instanced. Into one of his pictures of the naval review he did squeeze from twenty to thirty warships. His plate was 10 inches by 8 inches and he was compelled to station himself two miles off, and to use a telephoto attachment, which enlarged each object five diameters—that is, five times. Yet, in the print, all his ships are extremely small—not more than ⅝ inch in length; and if he had used a ¼ plate camera, they would not have been ⅛ inch in size.

It may be gathered from this that it is of not much use to attempt to photograph at a great distance. Yet what is two miles to a vessel going eighteen knots an hour? It is a matter of a few minutes' steaming only, and anyone who may attempt a sketch of a rugged coast from the deck of an approaching steamer, traveling at any rate, will at once perceive how in a few seconds the picture changes so as to be completely altered from the moment that the first stroke of the outline was drawn. Say, for instance, you are steaming toward Corbière Lighthouse from Jersey. The headland from which it juts out acquires a different form as you draw nearer, and the pyramid rocks themselves gain not only in definition, but change their shape as the course of the steamer alters on its way to Guernsey. These transformations are so rapid that only an instantaneous view can take note of them; yet, from the artistic standpoint, there is but one crucial moment when the picture of the Corbière is at its best, and it is precisely at that instant it should be "snapped."

Makers of photographic instruments are, of course, fully alive to the requirements of the marine photographic artist. It was from one well known firm—Messrs. William Watson & Sons, of 313 High Holborn—that Mr. A. Debenham, of Ryde, procured the 18 inch by 16 inch rapid rectilinear lens with which he took the magnificent picture of the Prince of Wales' yacht "Britannia," racing at full speed; and the same makers have, at different times, supplied other photographers, many of them of high social standing, who have turned their attention specially to this branch of the art. Among them may be named the late Lady Brassey and her daughter Beatrice, from whose negatives the Voyage of the "Sunbeam" was illustrated. Lady Brassey's method was this. She sat on deck in a chair, and a very heavy upright pole, 5 inches in diameter, something resembling that of a surveying instrument, was fitted into a socket in the deck, and on the top a mechanical arrangement, into which the camera was screwed, always kept the camera square in front of her, however much the boat might rock.

It may be taken for granted that a tripod cannot be used on board ship; the vibration is too great; although Captain Owen, late of the Union Steamship Company, has, I believe, employed one amidship, but only on exceptionally fine days and when the sea has been quite smooth. This officer is unrivaled in his yachting pictures, some of which may be seen at the Imperial Institute. It is his plan to sit in a little cabin on his yacht, and by mechanical means he can turn himself round to any point of the compass, so that he can always keep the yacht that he may be following in the field of his lens, until the supreme moment arrives for snapping it.

The question may naturally be asked, "When can the snapping time be determined?" Of course the use of "finders," as they are called, is well understood, but there are finders and finders. Mr. Debenham, as he goes about in his stout little dingey, often uses an ordinary finder, but Captain Owen, when he works on a large scale—i. e., with plates 10 inches or 12 inches square—employs a double camera. The two cameras are mounted on one baseboard, side by side. They have one focusing screw and one traveling frame, so that the coincidence is accurately kept. The view is watched in the left camera, which is hence the finder, and an exposure is made in the right just at the moment that the picture is perfect. In this finder the operator sees the object exactly under the same conditions as the companion camera secures it on the plate, which is a great advantage.

But amateurs who have not such serious work in mind may be content with a less elaborate apparatus. Watson's double camera has also twin lenses, but placed one above the other and not side by side. The finder is uppermost. When you raise the hood you see the image, full size, reflected upon a sheet of ground glass at the top of the camera by a mirror placed at right angles to the lens. This camera has also the advantage of permitting the operator to watch and wait for the most appropriate moment of exposure, when he squeezes the pneumatic ball, the use of which insures steadiness, and the trick is done. Hitherto, the principal drawback of a double camera has been the bulk, but this pattern is very little larger than an ordinary camera. Its dimensions for the half-plate size are 8¼ by 9 by 10, and weight complete 9 pounds. It is particularly adapted for use in the hand, and its great advantage is that the object can be focused up to the moment of exposure with absolute certainty of result. Such a camera, therefore, can be confidently recommended for work on board ship. Nothing is left to chance. You see your picture as you take it.

Now, is there any reason why this camera should not be further adapted for marine pictures? These are apt to be long and narrow, especially where long focus lenses are used. It would be an advantage in photographing a coast line, or a seascape, to use a 7½ inch by 5 inch horizontal plate; but this modification would involve an increase of bulk and weight. This consideration, however, might at sea be dismissed as of secondary importance. Of far greater necessity on board a large ship—it is not so essential on a yacht—is the long focus lens; and in the building of a camera specially suitable for marine work care should be taken that such lenses are included in the outfit. But you cannot expect them to do duty when snap shotting your fellow passengers. It would be as unreasonable as to use field glasses for reading an evening paper under your eyes.

The still less aspiring amateur, who does not aim at making long focus pictures a specialty, may very well be content with the lighter and inexpensive Vanneck hand camera, which has but one lens. The view finder is in the middle of the top of the box, and shows the same picture as is being taken on the sensitive plate, less the margin of the plate. The one lens is so arranged that when the image is seen sharply it is necessarily in focus on the plate. A turn of a screw immediately sets any object seen, near or distant, into perfectly sharp focus. With this camera you may use in one size a 4¼ by 3¼ inch glass plate or cut celluloid film, which is preferable to a roll film, or one of 3¼ by 3¼ inches. A dozen sensitive plates are contained in a holder at the back of the box, and at the top of the reservoir is a flexible bag into which the plate is raised by a lever, and thence lifted to the front ready for exposure when the spring is pressed. The Vanneck is most suitable for all general hand camera work, and, with an outer leather case, especially recommends itself to travelers.

One thing, in conclusion, must be borne in mind. Cheap cameras are usually costly in the end, and a good camera is worth its price.—J. H. Richardson, in Nautical Magazine.

A NEW STEAM PROPELLED AEROPLANE.

THE French Academy of Sciences recently received a description of an air ship constructed by Messrs. V. Tatin and Charles Richet. This new apparatus considerably exceeds Prof. Langley's aerodrome in size and speed. Langley's apparatus weighed about 22 pounds, and a speed of over 12 yards per second was obtained. The Frenchmen have produced an apparatus weighing 73 pounds and developing a speed of about 20 yards per second. The figures given include a water supply of 3 liters (weighing about 6½ pounds) and 900 grammes (about 1¾ pounds) of coal, sufficient for a flight of 5 kilometers, or a little more than 3 miles. So far, however, the longest flight has been only 140 meters (153 yards), the apparatus having a strong tendency to take headers. In this respect it is distinctly inferior to Langley's. The new apparatus cannot be experimented with except in perfectly calm weather, and even then it was necessary to start the machine on an absolutely horizontal flight, or it would tip over and come down suddenly.

The aeroplane consists of a very light frame of thin wood covered with silk. Attached to this frame are two fixed wings of like construction and of an area of 14½ square yards. The wings are connected with the body by steel wire. The machine further has a tail made of a wood frame and silk covering. A steam engine is used to drive two screw propellers, one of which is placed fore and the other aft, the two screws rotating in opposite directions.

To start the apparatus, it is placed on a car rolling down an inclined plane of 92 yards length and 11 yards height. At the end of the inclined plane an automatic appliance severs the connection between the car and the aeroplane, and the latter then proceeds on its free flight. The inventors are continuing their experiments, particularly in order to improve the conditions of equilibrium in their machine, and they hope to secure much better results when improvements have been made.—Der Stein der Weisen.

INCREASE OF RAIN IN MODERN TIMES.

"ACCORDING to M. Camille Flammarion," says the Literary Digest, which translates from La Génie Moderne, "who has compared all the hydrometric observations made at the Paris Observatory for about two hundred years, the amount of rain that falls in our regions is increasing yearly. This increase may be seen at the first glance by examining the averages of different periods. From 1689 to 1719 there fell an average of 485·7 millimeters [19·3 inches] of water.

" From 1720 to 1754	409·4
" 1773 " 1779	492·5
" 1804 " 1824	563·7
" 1825 " 1844	507·5
" 1845 " 1872	522·4
" 1873 " 1896	557·4

"It is certain that the year 1897 will be fully up to any of its predecessors in the matter of rain. The rainfall is increasing, then, at Paris, from period to period. To avoid this moist conclusion, we must maintain that the old observations were made carelessly. But—at the Paris Observatory! the thing is inadmissible! It would be interesting to compare with these numbers the heights of the Seine and the dates of its inundations. But, on the other hand, the modern construction of quays, the part played by the dams and weirs erected by our engineers, as well as the precautions taken against sudden rises, bring in an element foreign to meteorology, whose exact share in the results it would not be easy to confute."

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